
RAPID TRANSIT PLANS

FOR THE CITY OF SAN FRANCISCO

1931

H. M. OSHAUGHNESSY
CITY ENGINEER

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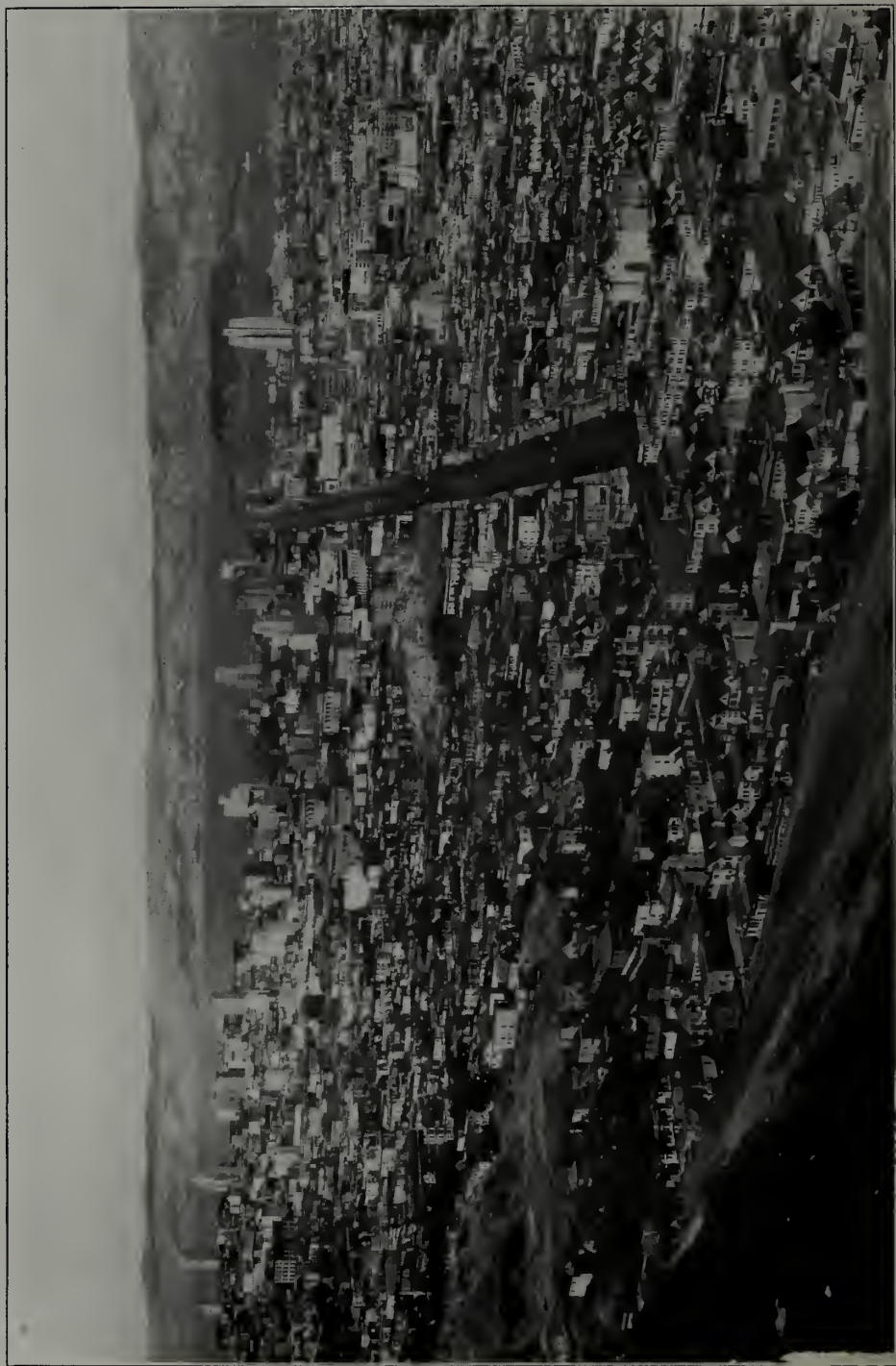
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VIEW OF SAN FRANCISCO LOOKING NORTHEAST FROM TWIN PEAKS.
May 20, 1930.

CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

REPORT ON

**RAPID TRANSIT PLANS
FOR THE
CITY OF SAN FRANCISCO**

WITH SPECIAL CONSIDERATION TO A
SUBWAY UNDER MARKET STREET

PREPARED BY

M. M. O'SHAUGHNESSY, City Engineer

UNDER DIRECTION OF THE BOARD OF SUPERVISORS
RESOLUTION No. 31461, NEW SERIES

MAY, 1931

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SAN FRANCISCO

FOREWORD

With the entry of two new transcontinental railways, the advent of natural gas, the near completion of the Hetch Hetchy Water Supply system providing an abundance of pure water, the improvement in automobile boulevards, and other symbols of progress, San Francisco, ever alive to its responsibilities, must give attention to the subject of traffic and transportation within its own boundaries.

Bonds for the construction of a bridge across the Golden Gate have been voted by the people of San Francisco. The East Bay bridge via Yerba Buena Island is being planned. Both these projects will definitely improve the means of entrance and exit to and from our City, further increasing automobile traffic.

There is no question that by following my recommendations contained in the report, requiring detail investigations, the solution of our street railway problems, the relief of unnecessary congestion by eliminating parking during the rush hours, and the reduction of the evening peak by staggering working hours, it will be possible to carry the increase in traffic, normally to be expected, without excessive loss through street congestion, until the first unit of our subway system can be completed.

All of the steps recommended must be taken before the subway may be constructed. By completing the preliminaries, the way will be cleared for constructing the subway quickly. A well conducted educational campaign among the property owners and their organizations will eliminate needless interference with the expeditious prosecution of the undertaking when once set in motion.

I wish to take this opportunity to give credit for the work done in the preparation of this report to the following men of my organization: Mr. Paul J. Ost, Chief Electrical Engineer; Mr. W. H. Ohmen, Chief Civil Engineering Designer; Mr. L. M. Perrin, Electrical Engineer, and Mr. A. V. Bowhay, Civil Engineering Designer.

City Engineer.

M. M. O'SHAUGHNESSY,

San Francisco,

April, 1931.

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CHAPTER I

INTRODUCTION

The growing traffic in the downtown section of San Francisco has made itself felt to the extent that a proposal to construct a subway under Market Street was taken before the appropriate committees of the City's Board of Supervisors. The result was that the City Engineer was instructed to prepare an engineering report on the subject of rapid transit. Funds to defray the cost of this work were provided in the 1929-30 budget, the actual appropriation being made by Resolution 31461, approved October 1, 1929.

A study has been made of the rapid transit systems of various cities, the types of construction used, construction costs, and methods of handling traffic. The results of these studies as applied to conditions in San Francisco are summarized in the following chapters. As the problems of no two cities are exactly alike, it was necessary to consider for San Francisco, all the fundamental considerations underlying the problem of mass transportation as a whole. In this report the matter of physical characteristics of the San Francisco Bay Region as affecting local transportation has been given particular attention in order that the initial plans will fit in with any future developments that can now be anticipated.

In the preparation of this report a number of studies have been made of present day transportation and traffic problems, also of future rapid transit requirements and possible routes. From these have come the recommendations at the conclusion of this report. The adoption and execution of these recommendations will clear the way to improve present conditions and most expeditiously provide for the construction of future urban transportation facilities.

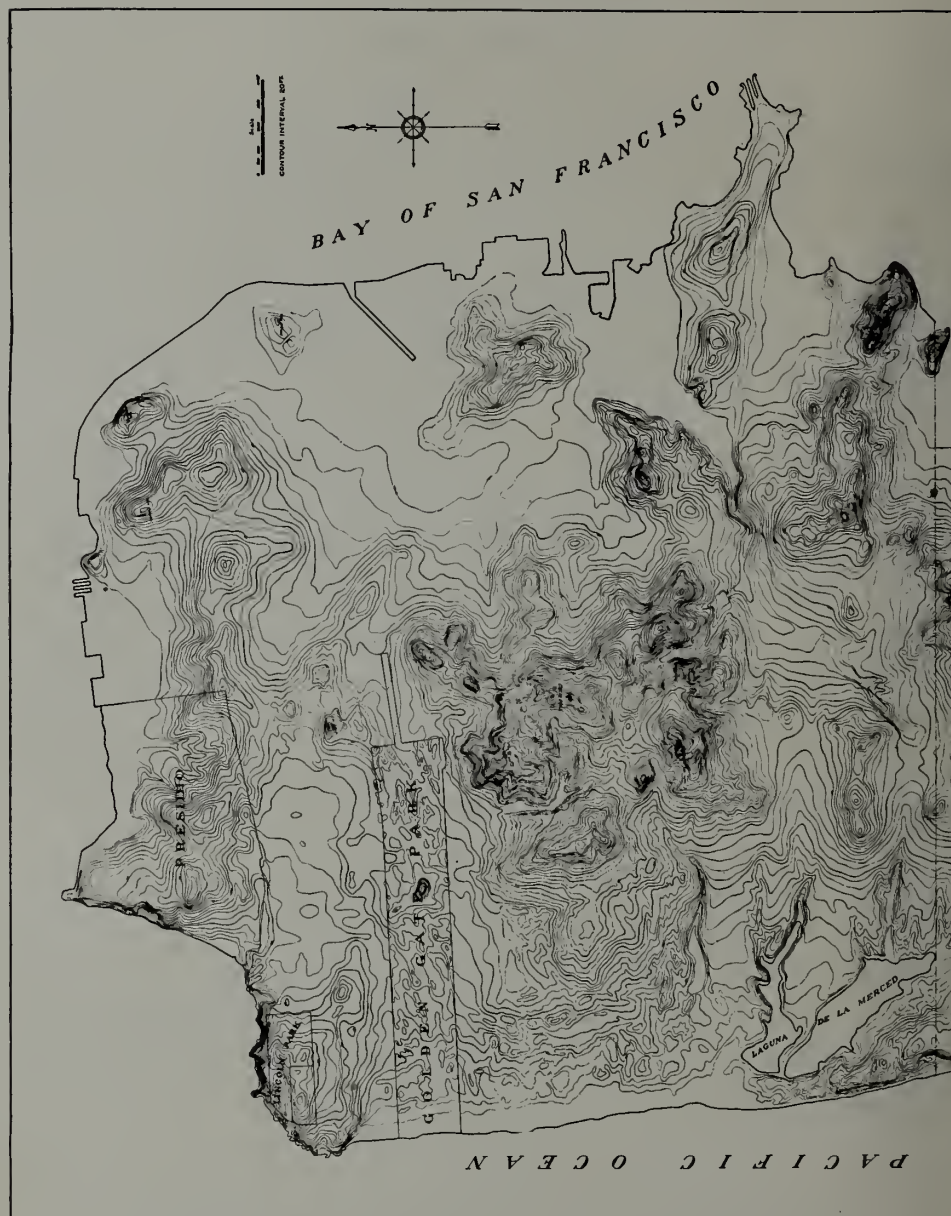


FIGURE 1.—TOPOGRAPHIC MAP OF SAN FRANCISCO.

CHAPTER II

PHYSICAL CHARACTERISTICS OF THE SAN FRANCISCO BAY AREA

Any rapid transit plans involving large financial investment must be made with special reference to future demands rather than to immediate conditions. The physical characteristics of the Bay Region are not subject to material change and should be studied as to their influence on the future city.

The San Francisco metropolitan area is unique in a number of different ways, many of which will play an important part in determining the distribution of the future retail, financial, industrial and residential districts. These are therefore summarized here insofar as they affect transportation requirements.

Geography

San Francisco proper is confined to a land area of approximately forty-two square miles at the north end of a rather narrow peninsula. This peninsula is made up of a chain of high hills, which, at the end where San Francisco is located, are broken up into several detached eminences. Thus a very rough surface area predominates with valleys and small sections of fairly level ground. Some of the hills within the City reach heights of over nine hundred feet above sea level.

The accompanying topographical map, Figure 1, on which are drawn contours at intervals of twenty feet, shows the general physical characteristics of the City. The hills south of San Francisco become higher, reaching proportions which in some places might cause them to be classified as mountains. To the west of the City lies the Pacific Ocean, to the north the straits of the Golden Gate, and to the east the Bay of San Francisco. Business and industrial interests have naturally built upon the fairly level portions of the town which are accessible to the largest part of the population. These areas are found mainly in the eastern section of the City. The hilly sections are used, as far as possible, for residential purposes.

Climate

On account of its location directly in the path of the incoming cooler air from the Pacific Ocean which moves toward the hot San Joaquin and Sacramento Valleys, the summer climate of San Francisco is the coolest of any large city in the United States. This coolness is accompanied during four summer months by fog and at times a considerable amount of wind. Many of the near by suburban areas are sheltered by the hills in such a way as to be normally free from cool winds and fog, at the same time having the temperature so moderated as to become ideal places of habitation. These peculiarities make it possible for residents of the Bay District to select, from a variety of climates, that best suited to their individual tastes. This fact has created some transportation problems, particularly with relation to suburban travel.

The bracing climate of San Francisco makes it an ideal place for work and the people of San Francisco are generally noted for their energy and alertness.

Suburbs

South of San Francisco, on the peninsula, the area between the hills and the Bay has been rapidly developed along the major lines of transportation. These naturally are along routes where reasonable grades are obtainable. A similar condition exists on the east side of the Bay, where high hills, which are an extension of the Coast Range, limit the usable area in that region to that lying close to the shores of the Bay. North of the Golden Gate the hills separating the Bay from the Pacific Ocean are considerably higher than those of the San Francisco Peninsula. Here again the population is forced to live in a relatively small area along the Bay shore. These features are shown on the topographical map of the San Francisco Bay District, Figure 2. Looking at this map it is readily seen that the more level areas are relatively small and in many cases are already fairly well built up within commuting distance of San Francisco.

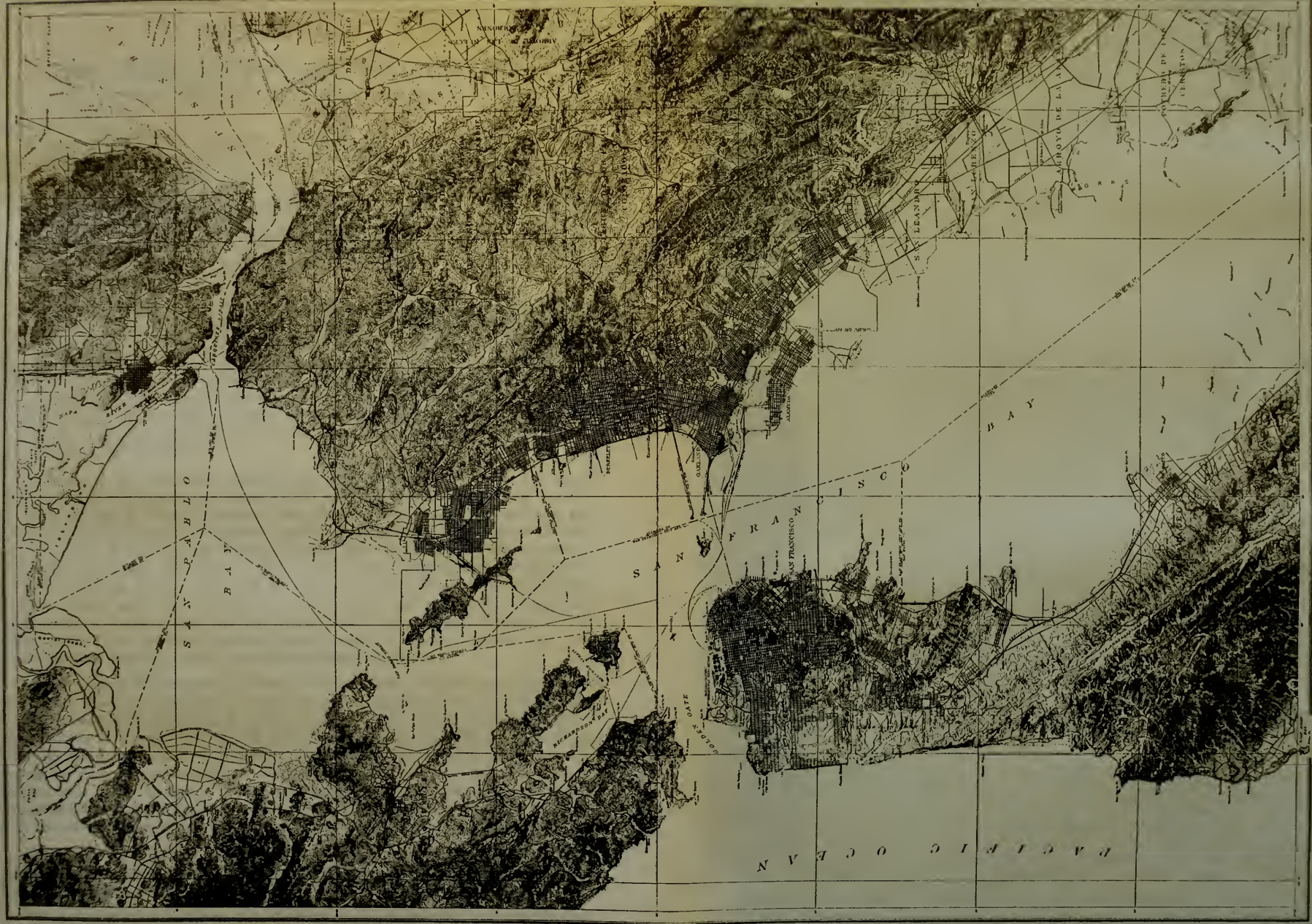


FIGURE 2.—TOPOGRAPHIC MAP OF SAN FRANCISCO BAY AREA.
Most of level area is remote from the City.

CHAPTER III

THE TREND OF DEVELOPMENT OF THE SAN FRANCISCO BAY AREA

Population

Most cities grow from the center outward, new residential districts being opened up on the fringes of the outer zones as fast as necessity demands. On account of the natural barriers consisting of Ocean, Bay and hills, it has been impossible for San Francisco to have a continuously expanding growth away from the center. For the reasons already given, suburbs separated from each other by hills, marsh lands or wind swept areas, have sprung up at various points around the Bay, wherever transportation and other conditions would permit. Naturally the more accessible areas have built up first and the less desirable or more difficult to reach, have been slower in growth.

While the suburban areas have been building up there has been a notable shift of population within the City. This is evident from Figure 3, which shows the gains and losses of population by Assembly Districts between 1920 and 1930. During this period Districts Nos. 22, 25, 29, 30 and 33 lost population because of expansion of commercial and industrial areas. The large gains were in the remote districts, indicating a shift of population away from the business center. This movement has increased the average distance between residence and place of employment and has created a growing demand for fast transportation, thus increasing the use of private automobiles.

In Figure 4 the population densities for San Francisco are shown for areas tributary to various groups of car lines. It will be noted that the maximum density, 71 per acre, occurs in Area I, between Van Ness Avenue, Market Street and the Bay; here the hill-top apartment house population more than compensates for the sparse population in the business district, a large part of which lies within Area I. Next in order of density are Area II, west of Van Ness Avenue, with 52 per acre, Area XI, the Mission District, with 43 per acre, and Area III, the Richmond District, with 34 per acre. In all three of these areas the apartment houses are gradually gaining ascendancy. The two most sparsely populated sections have 4 per acre—Area V, the southern Sunset District, which is largely unbuilt, and Area VIII, the Bayview District, which is predominately industrial.

On account of the relatively limited area available, property over the larger portion of San Francisco has been divided into twenty-five foot lots. On these have been built multi-family dwellings in such a manner as to make certain sections of the town solidly covered with two and three-story buildings for block after block. Multi-family residences are now becoming common in the East Bay Area and are beginning to make their appearance in the Peninsula section. As this type of growth becomes more necessary in the suburban areas, the desirability of leaving the congested city for the suburbs, also congested, becomes less and less—particularly as out of town residence always involves some transportation hardships.

During the past decade the Peninsula Area has shown the greatest growth, the aggregate population of the important communities having gone from 31,000 to 69,000 in the past ten years, an increase of 124 per cent.

The corresponding increase in population in the North Bay communities was from 16,000 to 25,000, or 55 per cent. The East Bay cities have increased from

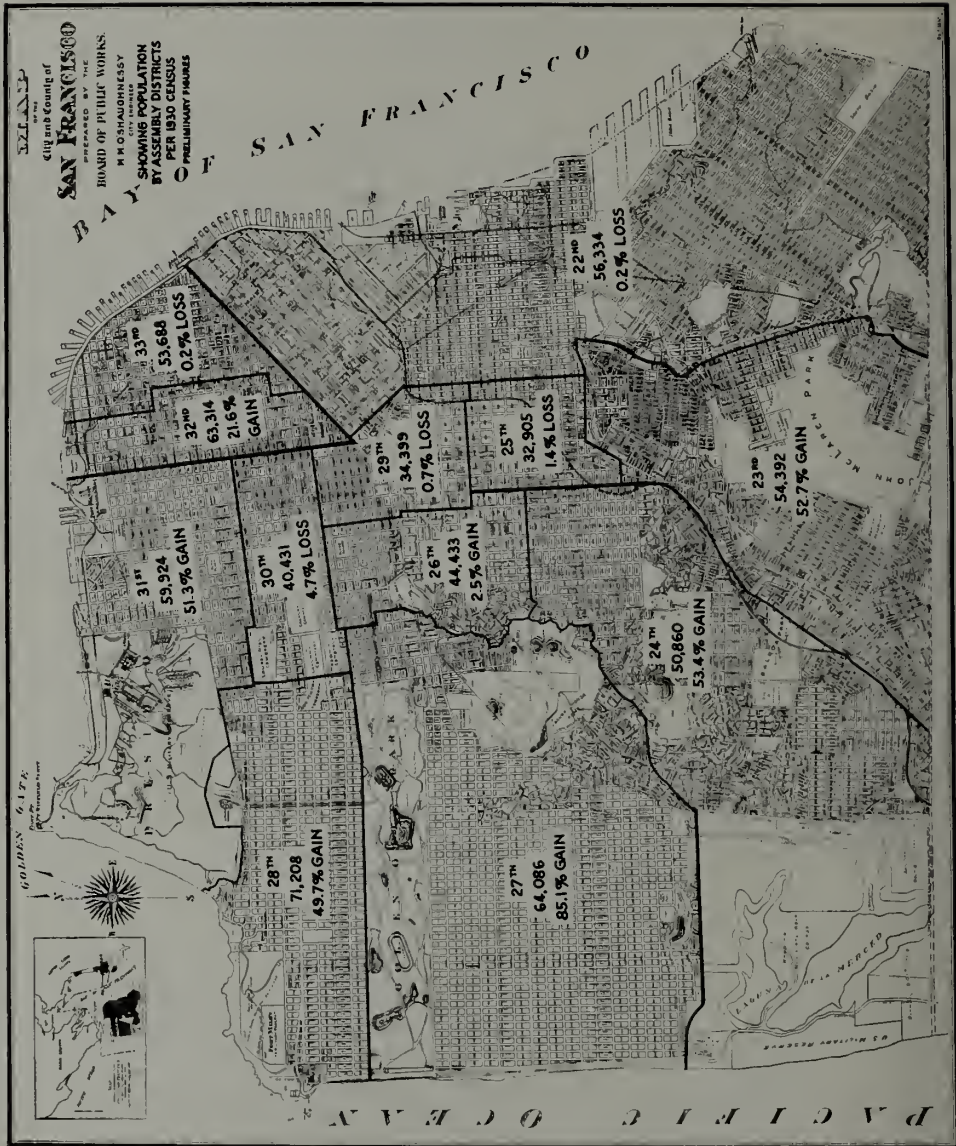


FIGURE 3.—POPULATION TRENDS BY ASSEMBLY DISTRICTS.
Large gains occurred only where there was extensive residential or apartment house building.

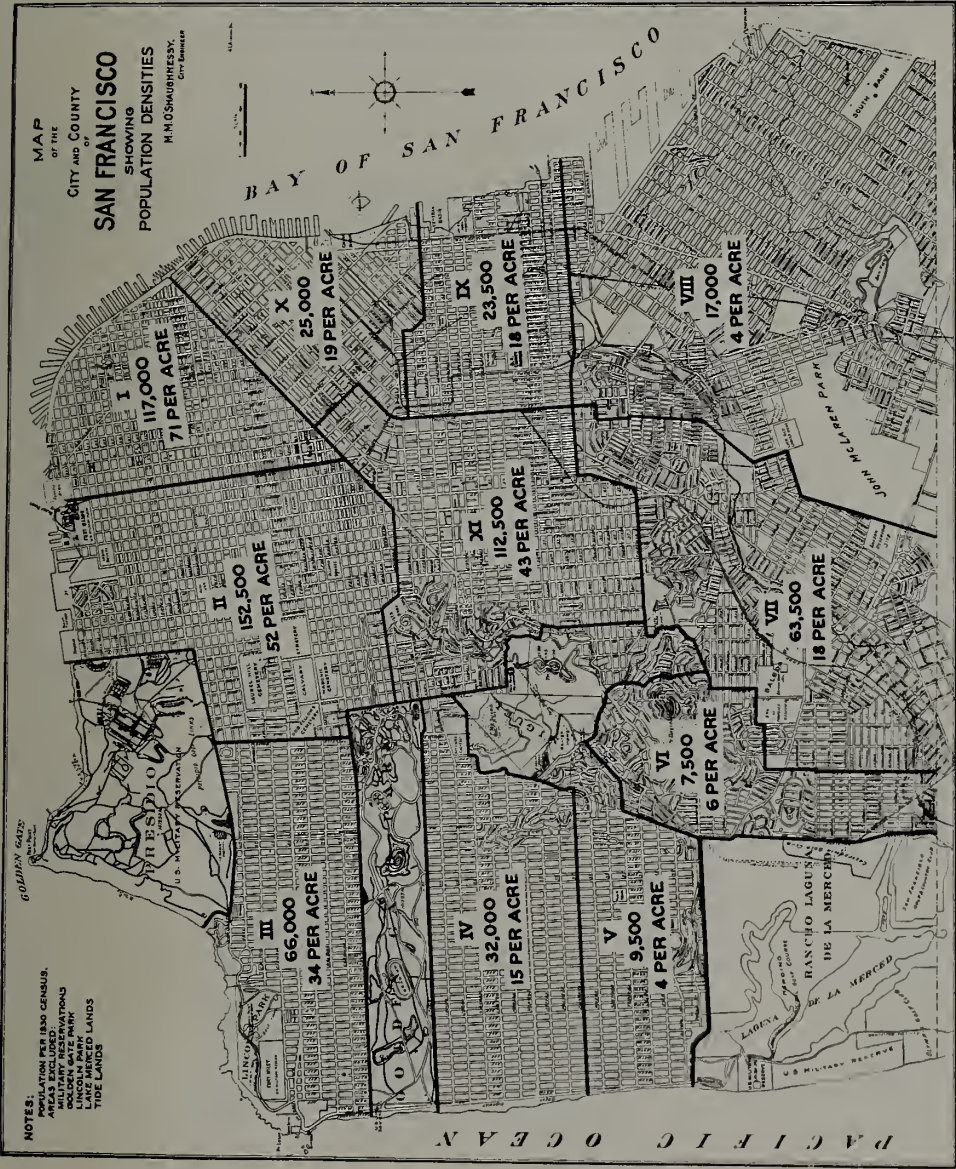


FIGURE 4.—POPULATION DENSITIES OF VARIOUS SECTIONS OF SAN FRANCISCO.
Area I leads because of large apartment houses on Nob Hill and Russian Hill.

336,000 to 457,000, or 36 per cent. In this same period the City of San Francisco has increased 26 per cent. It seems more than likely that during the next decade the growth of some of the suburbs will not be at such a rapid rate while the growth of San Francisco should continue as in the past, if not at a faster rate.

Details of the growth of the San Francisco Bay Area population in the past ten years, together with the percentage of increase over 1920, are shown in Table I.

TABLE I
POPULATION OF MUNICIPALITIES IN COMMUTING AREA

	1910	1920	1930	Per Cent Increase 1910-20 1920-30	
San Francisco	416,912	506,676	637,212	21.5	25.8
East Bay					
Alameda	23,383	28,806	34,392	23.2	19.4
Albany	808	2,462	8,592	204.7	249.0
Berkeley	40,434	56,036	81,543	38.6	45.5
Emeryville	2,613	2,390	2,335	-8.5	-2.3
Hayward	2,746	3,487	5,514	27.0	58.1
Oakland	150,174	216,261	284,213	44.0	31.4
Piedmont	1,719	4,282	9,309	150.0	117.4
Richmond	6,802	16,843	19,945	147.6	18.4
San Leandro	3,471	5,703	11,315	64.3	98.4
Total, East Bay	232,150	336,270	457,159	44.8	35.9
North Bay					
Belvedere	481	616	497	28.1	-19.3
Corte Madera	x	607	1,027	—	69.2
Larkspur	594	612	1,241	3.0	102.8
Mill Valley	2,551	2,554	4,164	0.1	63.0
Ross	556	727	1,356	30.8	86.5
San Anselmo	1,531	2,475	4,657	61.6	88.2
San Rafael	5,934	5,512	8,023	-7.1	45.6
Sausalito	2,383	2,790	3,661	17.0	31.2
Total, North Bay	14,030	15,893	24,626	8.9	54.9
Peninsula					
Burlingame	1,565	4,107	13,055	162.4	217.9
Daly City	x	3,779	7,833	—	107.3
Hillsborough	x	931	1,891	—	103.1
Palo Alto	4,486	5,900	13,635	31.5	131.1
Redwood City	2,442	4,020	8,957	64.6	122.8
San Bruno	x	1,562	3,609	—	131.0
San Mateo	4,384	5,979	13,439	36.4	124.8
South San Francisco	1,989	4,411	6,166	121.8	39.8
Total, Peninsula	14,866	30,689	68,585	64.2	123.5

x Unincorporated.

Table II shows the growth of population in San Francisco by ten-year intervals from 1890 to 1930 inclusive. Unlike most cities, growth in population attributed to San Francisco is of necessity an increase in the number of people in a given area as there has been no increase in the area of the City during the period covered by the table.

TABLE II
SAN FRANCISCO'S POPULATION

Year	Population	% Increase
1890.....	299,000	---
1900.....	343,000	15
1910.....	416,912	22
1920.....	506,676	22
1930.....	637,212	26

That the growth of San Francisco is of a very substantial nature, dependent upon the growth of the State as a whole, is very clearly indicated by the fact that the San Francisco Bay District has consistently contained between 30 per cent and 35 per cent of the population of the State since the year 1870; this shows that the interests of this portion of the State are so diversified as to reflect the progress of the entire State.

Table III shows the building permits issued in the State and in San Francisco from 1923 to 1928 inclusive and again indicates very clearly that San Francisco maintains approximately a constant relation to the State as a whole.

TABLE III
BUILDING PERMITS

	State	San Francisco	% of State
1923.....	\$423,401,000	\$46,670,000	10.7
1924.....	390,709,000	57,853,000	14.8
1925.....	405,546,000	50,293,000	12.4
1926.....	355,471,000	57,954,000	16.3
1927.....	319,997,000	47,033,000	14.8
1928.....	276,071,000	37,696,000	13.6

The actual experience of the largest cities is that the population tends to approach but does not reach saturation. After reaching a certain density of population, further increase in the Metropolitan area is largely confined to the outlying suburban districts. Such a condition is remote for San Francisco as there is still a large unbuilt area in the district west of Twin Peaks. Furthermore, many of the hills offer sites, permanently residential in character, that are particularly desirable for the better class of large apartment houses. This is evidenced by the rebuilding during recent years with de luxe apartment houses in the Nob Hill, Russian Hill and Pacific Heights Districts. These two elements of potential capacity can provide favorable living conditions for a much larger population in the City. If suitable transportation is provided and excessive traffic congestion in public streets avoided, there is no reason why the City should not show a greater rate of growth during the next few decades.

Business Trend

During the past few years the character of the East Bay District has changed to a large extent. For many years the East Bay territory was frequently spoken of as "the bedroom of San Francisco" and was largely made up of the homes of people employed in San Francisco. More recently a large number of industrial activities have been located east of the Bay thereby furnishing employment to a

large portion of the industrial population of this district who do not therefore commute to San Francisco daily. Practically all of these activities maintain their headquarters offices in San Francisco. The extent of this industrial development on the east side of the Bay is indicated by the tabulation of car loadings, unloadings and reconsignments set forth in Table IV. This shows San Francisco and Oakland activities from 1920 to 1928 inclusive. While San Francisco has had a steady and healthy growth, Oakland has had a much more rapid increase in this direction.

TABLE IV
CAR LOADINGS, UNLOADINGS AND RECONSIGNMENTS

	San Francisco	Oakland	Combined
1920.....	182,317	107,343	289,660
1921.....	143,604	79,160	222,764
1922.....	183,479	106,447	289,926
1923.....	212,546	134,141	346,689
1924.....	207,886	121,345	329,231
1925.....	230,880	145,047	375,927
1926.....	242,175	165,356	407,531
1927.....	233,551	175,608	409,159
1928.....	251,723	203,560	455,283

With the excellent systems of transportation from the East Bay District to San Francisco there is no question but that much of the best class of retail trade of the East Bay District is catered to by the San Francisco stores. The workers who commute add to the San Francisco peak hour traffic congestion while the shoppers are largely handled in off peak hours. East Bay commuter traffic finds its destination in the retail, financial and large office building area to the extent of more than seventy per cent. Such of these commuters as use the street railway facilities of San Francisco ride in the direction opposite to that of the peak load patrons living within the City. This improves the street car loadings of San Francisco by utilizing empty cars bound toward the Ferry in the evening and the empty cars leaving the Ferry in the morning. Records show that more than 24,000 leave San Francisco by the Ferry Building daily between 4:40 p. m. and 6:20 p. m.

Figure 5 shows in graphic form a number of factors which indicate the City's trend. These curves cover the years from 1908 to 1929 inclusive and are very conclusive evidence of the stability of San Francisco's business foundation.

Present indications are that San Francisco will continue to be the financial and business metropolis of Northern California and as such will have an ever-increasing downtown population housed in tall office buildings, which will add to the congestion of the downtown district.

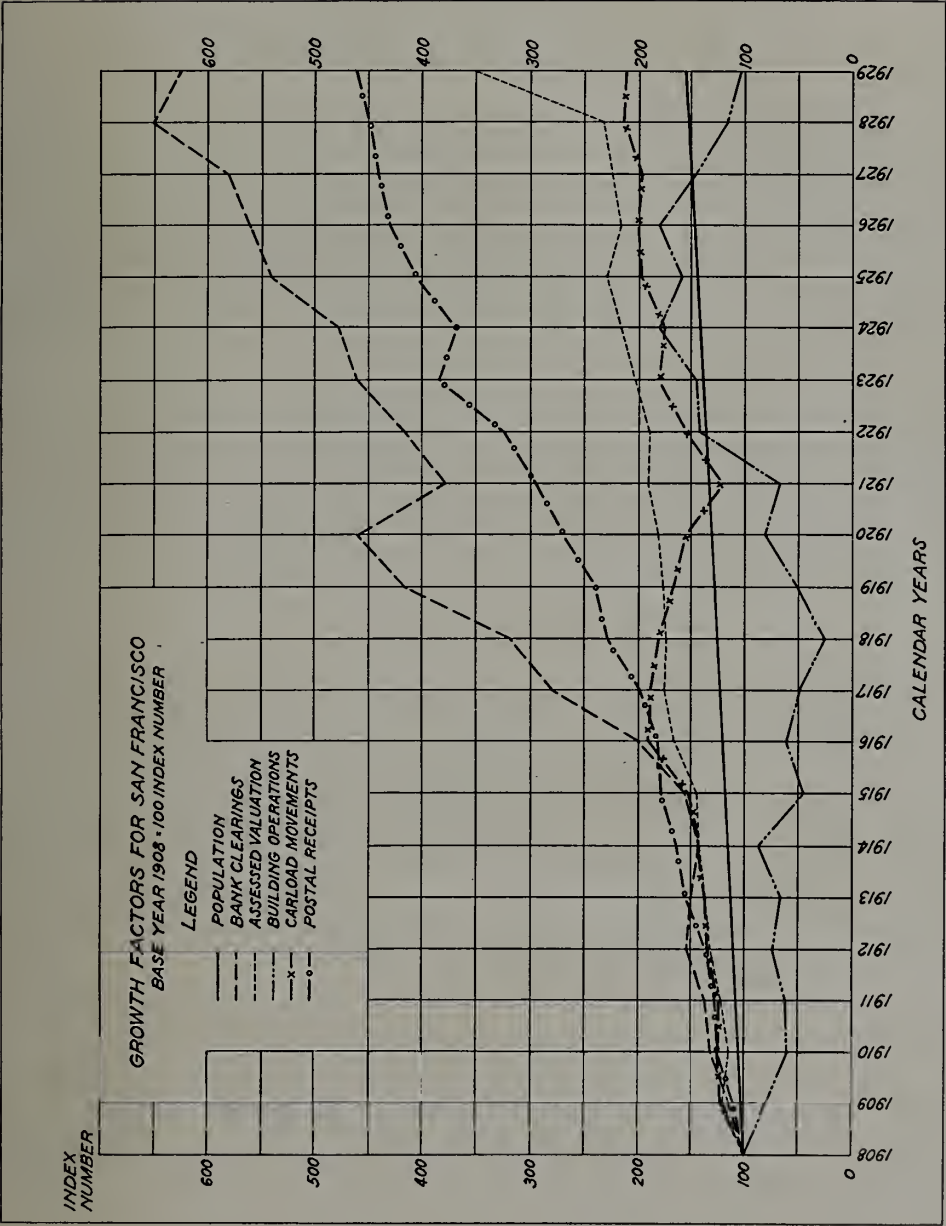


FIGURE 5.—GROWTH FACTORS FOR SAN FRANCISCO.
Apparent recession in building operations followed completion of rebuilding after the 1906 disaster.
The other factors are remarkably free from evidences of booms or depressions.

CHAPTER IV

SAN FRANCISCO'S CITY PLAN

San Francisco is decidedly unique in the way of topography. It has been already stated that the end of the San Francisco Peninsula contains a number of hills which are a part of the ridges extending both north and south from the City. As a result, many of the City streets are on very heavy grades. A map prepared by the San Francisco Traffic Survey Committee shows by legend the grades encountered on the various streets throughout the town. This map, which is presented as Figure 6, clearly indicates how the downtown district is hedged in on the north by grades of ten per cent and over; it also indicates the relatively level section south of Market Street and in the Mission District.

There has also been prepared Figure 7, which is a map showing the location of the principal residential, business and industrial areas. Comparing this with Figure 6, it is readily seen that business and industry have confined their activities almost exclusively to the level parts of the City, leaving the more hilly portions for residential use. This is a condition which will no doubt never be greatly changed. These conditions, combined with the concentration of the shipping business along the waterfront, has held the business and the high value district very close to the northeast corner of the City.

Street Pattern

Market Street, which is the principal artery, has a width of one hundred and twenty feet, seventy-six feet between curbs and two sidewalks, each twenty-two feet wide. It was laid out in such a direction as to encounter the least grades and best serve the level portions of the City. This was done in the pioneer days with no great thought for the possible results to be experienced when the City became the metropolis of the Pacific Coast. This street, with its length of three miles and width of one hundred and twenty feet, is not equaled by many streets in the United States. It now carries four street car tracks and between the car tracks and the curb on each side, provides space for one lane of automobile traffic with room for parking one row of automobiles against the curbing.

While Market Street, which runs North, 45 degrees East, was surveyed to fit the ground surface, the streets north of Market were laid out to correspond with the points of the compass without regard to topographical conditions. For this reason all of the streets to the north of Market meet it at an angle and because of this diagonal relation to the other streets, most of the carlines running downtown from the westerly sections of the town converge on this one street, thus creating the necessity for the four tracks. Figures 8 and 9 indicate more clearly than words why it is not feasible to open up a new thoroughfare north of and parallel to Market Street.

The streets south of Market Street have a general width of 82 feet six inches and are laid out in a rectangular pattern so as to run either parallel to or at right angles to Market Street. The center to center spacing of these streets is in most cases abnormally great being 633 feet for streets parallel to Market, and 908 feet for streets at right angles to Market Street. Many of the blocks are divided parallel

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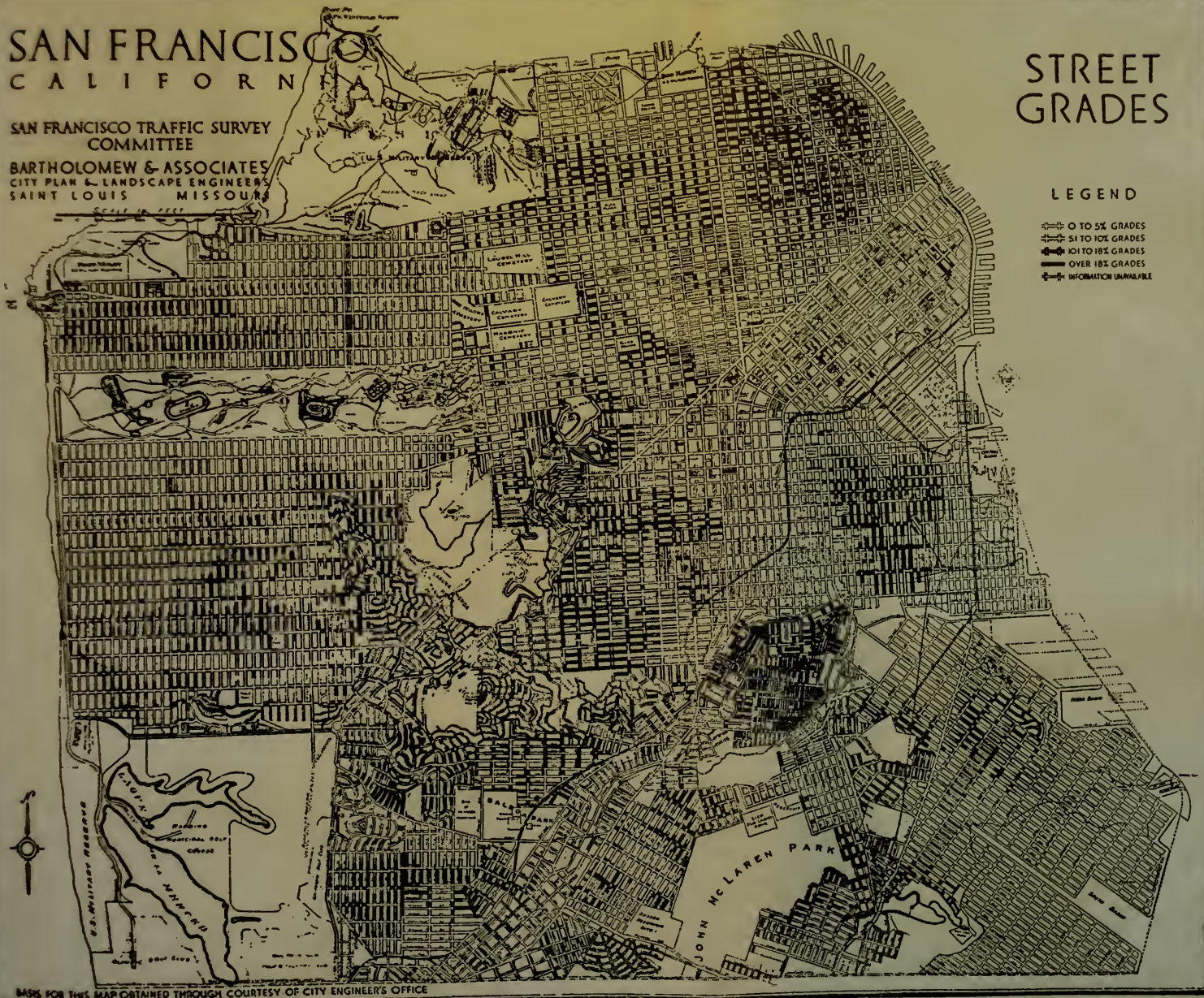
SAN FRANCISCO TRAFFIC SURVEY
COMMITTEE

BARTHOLOMEW & ASSOCIATES
CITY PLAN & LANDSCAPE ENGINEERS
SAINT LOUIS MISSOURI

STREET GRADES

LEGEND

- 0 TO 5% GRADES
- 5.1 TO 10% GRADES
- 10.1 TO 15% GRADES
- OVER 15% GRADES
- INFORMATION UNAVAILABLE



BASES FOR THIS MAP OBTAINED THROUGH COURTESY OF CITY ENGINEER'S OFFICE

FIGURE 6.—SAN FRANCISCO STREET GRADES.

Rectangular block plan on hillsides produces grades impassable to vehicles other than cable cars.

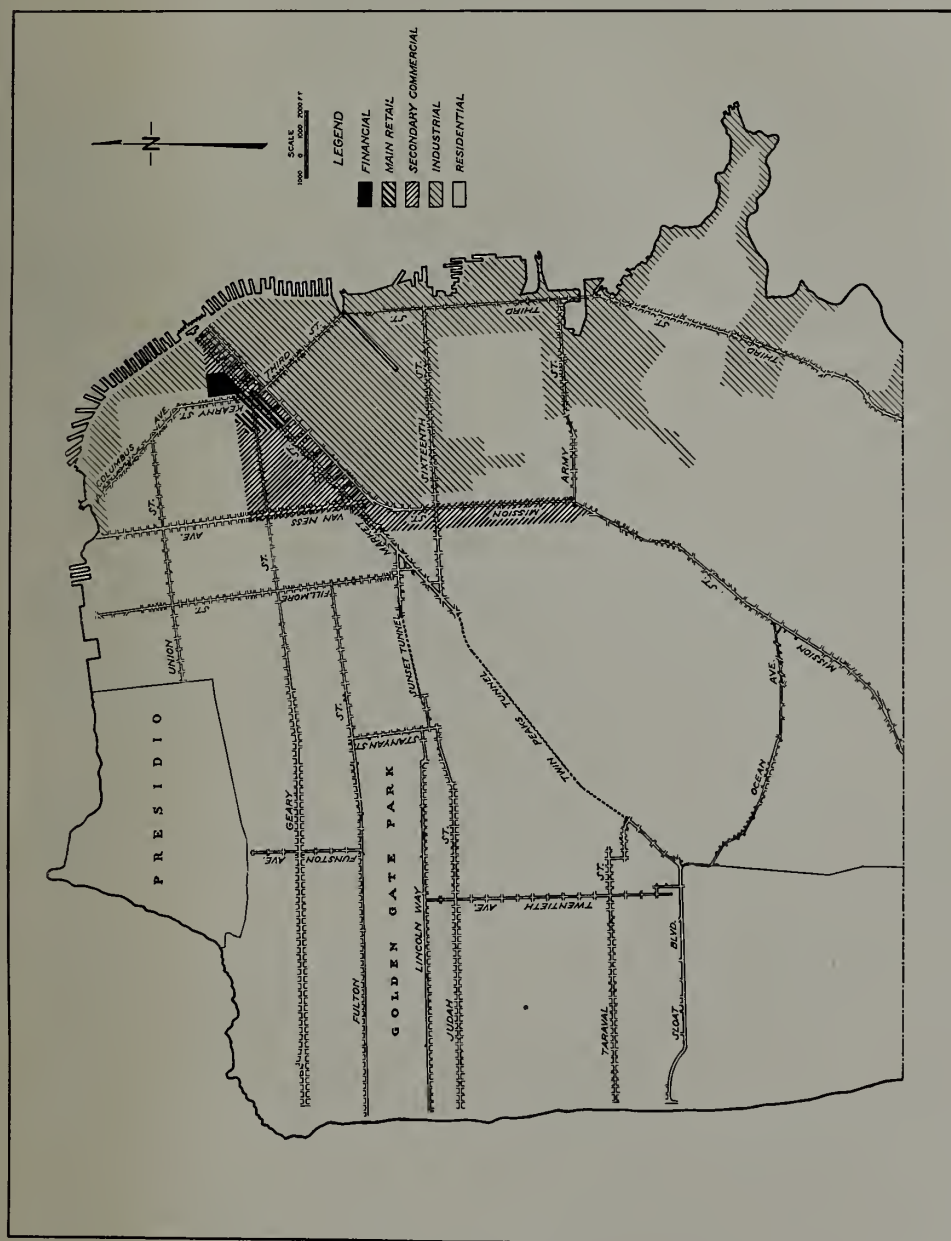


FIGURE 7.—LOCATION OF PRINCIPAL BUSINESS, INDUSTRIAL, AND RESIDENTIAL AREAS.
Expansion of business and industrial areas is in direction of low grades.

to Market Street with two narrow streets usually not exceeding 35 feet in width between building lines. It is the exception rather than the rule that these narrow streets run continuously through adjacent blocks. This fact together with their narrowness, makes them useless as through routes; thus almost all traffic must be borne on the wider streets.

South of Market Street

The large size of the blocks formed by the major streets has without doubt worked very materially against the development of the district south of Market Street into a retail or office district, for the reason that the centers of these blocks are practically inaccessible for retail trade and not at all desirable as sites for large office buildings. Consequently this area is at the present time very largely devoted to wholesale business and light manufacturing, whereas the area north of Market Street is occupied by high value retail business and large office buildings. The marked difference in the character of the districts north and south of Market Street is clearly shown in the frontispiece and by comparing Figures 8 and 9 which show Market Street, and the financial district north of it, with Figure 10 which shows Mission Street looking east from Fifth Street. These photographs clearly illustrate that the value of property south of Market Street has not enhanced at anything like the rate of that north of Market Street. Information covering the entire downtown area as set forth by Plate 1, illustrates in a comprehensive manner the relative heights of the buildings north and south of Market Street and the relative size of the blocks.

One indication as to the possibilities of this district if broken up into smaller blocks, is the marked difference in character of New Montgomery Street compared with the other streets south of Market Street. The distance from Second Street to New Montgomery is 281 feet and both of these streets have a considerable amount of the better class of business, New Montgomery Street particularly having several large office buildings, notable among which is the headquarters of the Pacific Telephone and Telegraph Company.

It therefore seems logical that the breaking up of some of these long blocks by the opening up of reasonably wide streets running at right angles to Market Street, would very materially improve property values in the blocks subdivided. Possibly even the opening of pedestrian arcades through some of these blocks, would considerably more than pay for the cost.

The spreading out of the retail and office district incident to such a change in the street plan would have a material effect on the transportation system as it would tend to remove the heavy congestion on Market Street and would provide means of diverting some of the traffic across Market Street rather than to confine most of it to traveling the length of Market Street. Careful planning of the location of these streets would also relieve another serious condition brought about by the fact that now at only a few places do the streets north of Market Street come into that thoroughfare opposite streets to the south. This concentrates cross traffic at a few intersections, which interferes with the flow of Market Street traffic to such an extent as materially to cut down the street capacity. When streets stop at Market Street with no outlet opposite, it either requires that a considerable amount of traffic make a left-hand turn, or prohibits the use of the intersections except when used with a right-hand turn. Traffic on side streets is again increased in order that it may reach an intersection where it can cross.

These additional streets as well as relieving traffic congestion will provide unloading space, and, until such time as parking is entirely prohibited in the down-



FIGURE 8.—VIEW OF BUILDINGS IN FINANCIAL DISTRICT, APRIL, 1927.
Buildings in foreground front on Market Street. Sansome Street at right.



FIGURE 9.—VIEW OF MARKET STREET EAST FROM MASON STREET, JUNE 6, 1934.
Building heights are greater on north of Market Street.



FIGURE 10.—VIEW OF MISSION STREET EAST FROM FIFTH STREET, JUNE 6, 1934.
Wholesale establishments predominate.

town area, will make room for many more parked cars in the business section. In addition to opening some new streets at right angles to Market Street, it would be well while buildings are small and values relatively low, to widen and open through some of the narrower streets parallel to Market Street.

When the transbay bridge connecting San Francisco with Oakland and Alameda is constructed with the proposed elevated loop south of and parallel to Market Street, there will follow an increase in the amount of travel on the streets running south from Market. All traffic originating north of Market Street and intending to use the Bay Bridge, must cross Market Street and, as just pointed out, there is now marked congestion at the only feasible crossings of Market Street to which the transbay traffic will materially add. Increased facilities for crossing Market Street will have to be provided, otherwise such traffic congestion will be created at Third, Fourth, and Sixth Streets as materially to interfere with traffic both on Market Street and the cross streets.

It therefore seems advisable that the subject of new streets south from Market Street should be given careful consideration, not only for the benefit of the district south of Market Street, but for the benefit of the City as a whole.

Retail District

It has already been pointed out that the district a few blocks north of Market Street, is quite hilly, which has resulted in the streets being extensively devoted to hotels and apartment houses. The density of population in this area is very high, which fact may contribute to the maintenance of the retail business north of Market Street, as that class of business usually moves toward the direction from which customers approach. Considerably more than one-half of the present population of this City lives north of Market Street and comes downtown on east and west car lines which traverse the retail and financial district as it now exists. These lines run into Market Street. A large number of those going into these districts likewise come into the City through the Ferry Building at the foot of Market Street, while a lesser number come into the City through the Third and Townsend Station. From the south of Market Street there are but three car lines which run on Market Street while a number make Market Street a terminal point.

The above conditions will tend to retard any shift of the retail shopping district from its present location. Under any condition it seems likely that Market Street will continue to hold its supremacy as the main thoroughfare for many years to come. While there has been a tendency for the business to shift westward on Market Street, this trend seems for the time, to have expended itself and the rebuilding of property along the easterly end of the street will help retain the place which this portion of the City has always held.

CHAPTER V

PRESENT TRANSPORTATION FACILITIES

Urban Railway Transportation

San Francisco is particularly well supplied with street railway service. Figure 11 is a map of the routes operated by the three systems now serving the City. Of these three systems, two, the Market Street Railway and the California Street Cable Railroad, are privately owned, and the third, the Municipal Railway, is owned and operated by the City. Data covering these three roads are given in Table V.

TABLE V
DATA ON STREET RAILWAYS OF SAN FRANCISCO AS OF
DECEMBER 31, 1929

	California St. Cable Railroad	Municipal Railway	Market St. Railway System	Total
Miles Single Track.....	11	78	284	373
Passenger Cars:				
Electric	---	234	727	961
Cable	48	---	51	99
Buses	---	18	6	24
Revenue Passengers in 1929.....	9,879,000	72,431,000	194,429,000	276,739,000

The California Street Cable Railroad, as its name indicates, operates cable cars only. There are but two main routes to this system, one operating east and west, and one north and south. The Market Street Railway operates electric and cable cars and a few gasoline buses. The system covers practically all sections of the city. Electric cars and buses are operated by the Municipal Railway which connect the downtown district with the most important residential areas. At the present time all of these lines are operated at a five-cent fare with free transfers between the lines of each system, and free transfers at a few points between the lines of two systems.

Through the vote of the people on November 4, 1930, the two private companies are now able to secure an extension of their franchises for twenty-five years under such terms as to make them virtually perpetual as they can only be terminated through the purchase of the properties by the City. Since 1929 the California Street Cable Railroad and the major portion of the lines of the Market Street Railway, have been operating without franchises under sufferance. As yet it is too early to predict what effect the extension of franchises will have on the street railway service. The Market Street Railway in its pre-election statements, promised a number of extensions and great improvement of track and rolling stock. No promises were made by the California Street Cable Railroad as to any action which they would take looking toward the betterment of their service.

In common with all of the street railways of the country, the San Francisco lines have had a marked decrease in patronage since 1925 as indicated by Figure 12. This decrease is almost entirely due to competition from private automobiles. It



PACIFIC OCEAN





FIGURE 11.—STREET RAILWAY MAP.
Most of the east and west lines run into Market Street.

is to be expected that the effect of this competition will be less in the future because of the limitations of automobile parking and storage space in the business areas. Patrons are demanding that transportation be more rapid and more convenient and this demand under present conditions, is most satisfactorily met by the automobile. Further congestion of the downtown district will decrease the amount of time saved through the use of automobiles and it is only by the operation of mass transportation at a different level from street traffic that gain in time may be expected. This gain in time, together with the difficulty of finding parking space, will doubtless bring back to the public conveyances a considerable amount of patronage, now lost to the private automobile.

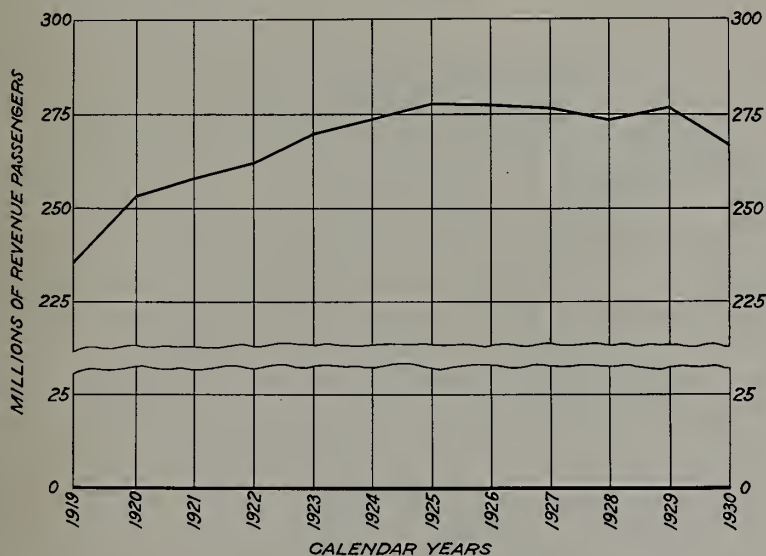


FIGURE 12.—GRAPH OF TOTAL REVENUE PASSENGERS.
San Francisco Street Railways.

Figures 13 and 14 show by zone lines the time required to reach various portions of the City from the Ferry Building and from Third and Market Streets over the present street railway lines. These zones show the actual time from these termini and other points via the most direct car service. For points between car lines an allowance is made for average walking time. Attention is called to the fact that it takes from forty-five to fifty minutes riding time to reach the most remote parts of San Francisco from the Ferry Building and forty to forty-five minutes from Third and Market Streets. The maximum riding distance from Third and Market Streets to outlying parts of the City is approximately seven miles.

Taxicabs and Jitneys

Aside from the service furnished by the three street car systems, the only other means of public transportation within the City is by taxicab or jitney. During the past few years there has been a very marked increase in the number of taxicab companies operating and the number of cabs in service. On July 15, 1930, there were nineteen companies and forty-two individuals actually operating 645 taxicabs while holding permits to operate 1142. The resulting competition has greatly reduced rates and provided service much in excess of existing needs. Aside from the competition offered the street railways, these taxicabs add very greatly to the congestion in the streets whether cruising or parked.

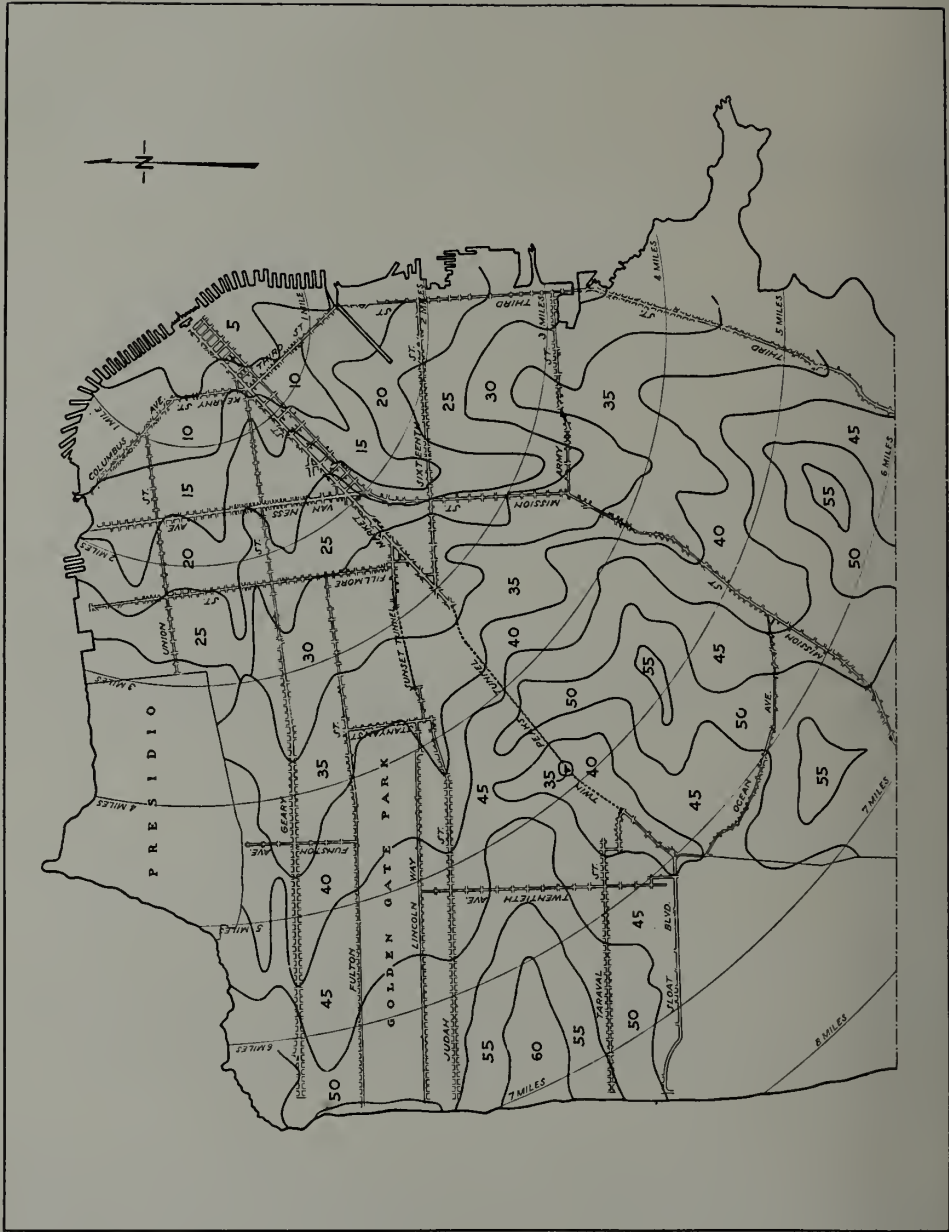


FIGURE 13.—PRESENT TIME ZONES FROM FERRY BUILDING DURING P.M. RUSH.

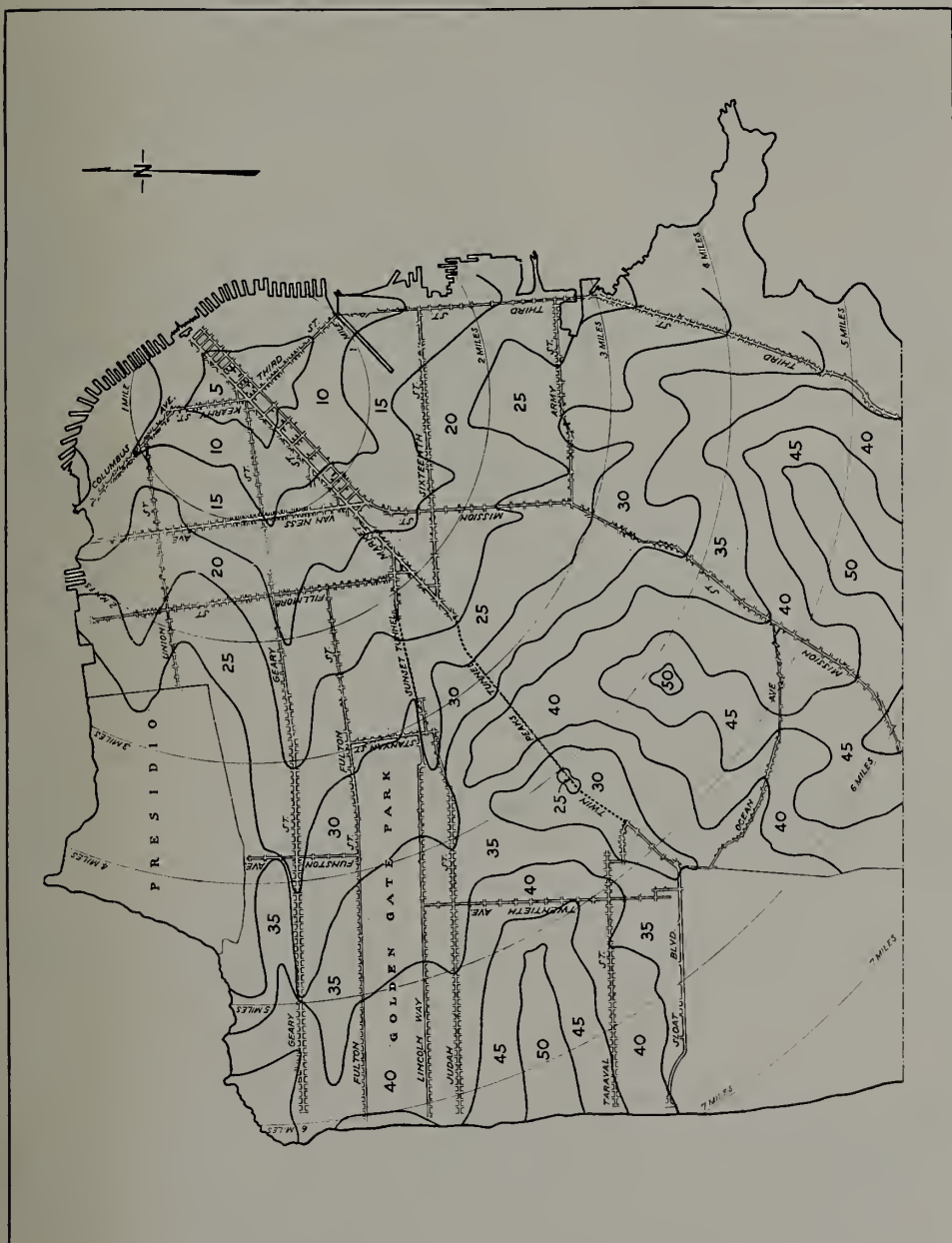


FIGURE 14.—PRESENT TIME ZONES FROM THIRD AND MARKET STREETS DURING P.M. RUSH.

At one time a very great number of jitney buses were operated parallel to street car service over a number of the City streets. These are now greatly decreased in number and during the first six months of 1930 there were issued licenses for 142 jitneys of which about 120 were being operated. At the present time these jitneys, which are large standard passenger automobiles, are striving to furnish express service along street car routes. Their rate of fare is ten cents and outside of the morning and evening rush hours, they do a relatively small business, in fact, some routes are not operated except for a short while in the morning and evening.

Suburban Transportation

Attention has already been called to the peculiar location of San Francisco on a peninsula. As is indicated by Figure 2, transportation to and from San Francisco, except to the south along the Peninsula, involves crossing some portion of San Francisco Bay. Figures 15 and 16 show by dotted lines the more important passenger ferry routes, all centering at the foot of Market Street.

The East Bay is served by passenger ferries operated by the Southern Pacific Golden Gate Ferries Limited, the Key System and the Southern Pacific Company. The Key System and Southern Pacific Ferries operate in conjunction with extensive electric suburban lines in the East Bay area. Passengers are taken from the Ferry Building in San Francisco to piers on the east side of the Bay, where they connect with trains serving Oakland, Alameda, Berkeley, Emeryville, etc. The ferry boats running to Richmond connect with automobile buses which take passengers from the pier into the town. Service is furnished during business hours at twenty-minute intervals for Oakland and Berkeley and one-half hour intervals for Alameda and considerably longer intervals for Richmond.

The passenger ferry to Sausalito serving Marin County, is operated by the Northwestern Pacific Railroad from the Ferry Building. From Sausalito the same railway operates electric interurban trains to Mill Valley, San Rafael, Fairfax and many other points. This service has a minimum headway of thirty minutes during business hours of the day.

Main line passengers east and north are handled over these same ferry routes and in addition the Santa Fe Railway operates a separate ferry from the Ferry Building to Richmond, and the Western Pacific from the Ferry Building to Alameda.

Ferry service for automobiles is operated by the Southern Pacific Golden Gate Ferries Company from the Ferry Building to the Oakland Pier and from the foot of Hyde Street in San Francisco to a pier extending westward from Berkeley. Automobiles are carried on the Northwestern Pacific Railroad Sausalito Ferry and a separate automobile ferry line is operated by the Southern Pacific Golden Gate Ferries Company from the foot of Hyde Street to Sausalito. Both passengers and automobiles are carried on the ferries running from just north of the Ferry Building to Vallejo. Connection is made at the Vallejo pier with the Napa Valley Electric Railroad. This service is operated approximately every two hours. Automobiles are carried on the Richmond and Alameda passenger ferries.

The importance of the ferry service and the effect that the automobile has had on the number of foot passengers carried is very definitely shown in Table VI.

TABLE VI

EAST BAY FERRY TRAFFIC

(Including ferries to Richmond, Berkeley, Emeryville, Oakland and Alameda)

Year	Foot Passengers	Auto Passengers	Total Passengers
1915.....	36,134,000	1,750,000	37,884,000
1916.....	31,437,000	1,634,000	33,071,000
1917.....	33,301,000	1,905,000	35,026,000
1918.....	35,012,000	1,962,000	36,974,000
1919.....	37,823,000	2,301,000	40,124,000
1920.....	37,619,000	2,610,000	40,229,000
1921.....	36,847,000	2,818,000	39,665,000
1922.....	36,879,000	2,747,000	39,626,000
1923.....	38,938,000	3,270,000	42,208,000
1924.....	39,536,000	3,464,000	43,000,000
1925.....	39,847,000	4,086,000	43,933,000
1926.....	37,272,000	6,707,000	43,979,000
1927.....	36,641,000	8,275,000	44,916,000
1928.....	35,443,000	9,611,000	45,054,000
1929.....	34,360,000	10,174,000	44,534,000

This table shows a decrease in the number of foot passengers since 1925, but in this period the number of passengers carried by automobile has more than doubled so that the total number of passengers transported on the East Bay Ferries has shown an increase of 33½ per cent since 1916.

In Table I it was shown that the Peninsula area had a growth of 124 per cent during the past decade. A very large proportion of this population commutes to San Francisco, the most popular service being that rendered by the Southern Pacific Company's steam trains. These trains, which are made up of standard steam railway steel coaches, operate over the company's main lines running south. Trains operate at varying headways corresponding with the amount of business at different hours of the day. During the evening and morning rush hours, trains leave or arrive at intervals of less than five minutes. In addition to the Peninsula service rendered by the Southern Pacific Company, which reaches to San Jose and Los Gatos, electric interurban car service is given by the Market Street Railway Company as far as San Mateo, which also operates at headways dependent on business. The third service is that given by the Peninsula Rapid Transit Company over the State Highway known as El Camino Real. This company operates gasoline propelled automobile buses.

That the service given by all of the interurban operating companies is very excellent is shown in Figure 15, which gives the time required during the evening rush hour to reach various points in the Bay District leaving from Third and Market Streets in San Francisco. The figures shown on the map adjacent to the various suburban communities represent the number of minutes required to travel from Third and Market Streets to the average residence in the community. These figures are made up of time spent on the ferry and train, together with street car time from Third and Market Streets to the San Francisco interurban line terminal, and ten minutes walking time after leaving the suburban station. Attention is called to the fact that the quickest service is given to the Peninsula communities. The long time consumed in boat travel works a hardship against



FIGURE 15.—SUBURBAN TRAVELING TIME.

From Third and Market Streets during P. M. Rush. Ferries slow up transbay service.



FIGURE 16.—SUBURBAN FARE ZONES USING COMMUTATION TICKETS.
Many passengers pay street car fares in addition.

those whose journey includes a ferry trip. This is exemplified by the time required to reach the Marin County communities and Richmond, which are fairly close compared with some towns on the Peninsula.

By comparing Figures 14 and 15 it will be seen that some of the Peninsula suburbs are closer in time to the business center of San Francisco than are the more remote residence sections of the City. This, however, applies only to rush hours when the interurban lines provide express service. At other hours of the day the City dweller has the advantage, particularly so when consideration is given to the frequency of City service compared with the infrequency of Peninsula service.

The cost per ride in cents to these outlying districts has been shown in Figure 16 by fare zones based on the use of monthly commutation tickets for the full calendar month. These tickets are sold by all companies and provide the purchaser with a ride to and from the City each day of the month. The tickets are dated and are good only on the day so indicated. To the interurban fare must be added in many instances the cost of street car or bus rides at one or both ends of the suburban trip. The figures for Richmond include an allowance for a bus ride from the pier to the town.

Table VI, together with records of the sale of commutation tickets, leads to the conclusion that little or no increase in commuter traffic from the East Bay District can be expected with the present facilities. The suitable areas within reach of suburban trains are now mostly built up and further increase in population must be largely through the use of multi-family dwellings, consequently the advantages of suburban residence in this district may not be available a few years hence.

It might be expected that the long ferry trip and the infrequency of service to the North Bay District would have hampered the development of this territory. However, in Marin County there is very little unoccupied land convenient to the train service that is suitable for commuter residence. Consequently very little increase in traffic is to be expected in this direction.

In the Peninsula District the most accessible of the desirable areas have already been built up. There is space beyond Palo Alto to accommodate a very large suburban population; however, the traveling time and rate of fare militate against early and dense settlement.

In summing up the suburban transportation offered and advantages of living in outlying localities, it appears that the next few decades should produce a much faster relative growth for urban San Francisco. As the majority of commuters are office workers, a shift in residence to San Francisco of any considerable proportion of these will make necessary increased transportation facilities between the residential and central business districts.

Transbay Bridges

During the time consumed in the preparation of this report the people of the City have voted to bear the major portion of the estimated cost of constructing a bridge across the Golden Gate. The balance of the funds have been voted by those living north of the Bay. This bridge will not be completed for a number of years.

At the present time, travel between the North Bay District and San Francisco is divided between that coming into the foot of Hyde Street via the Golden

Gate Ferries and that coming into the Ferry Building at the foot of Market Street, via the Northwestern Pacific Railway; the former route carries automobiles primarily. The Northwestern Pacific business is largely that of carrying pedestrians. For the time being at least, it seems as though this pedestrian traffic will not be greatly changed by the construction of the bridge. There is no doubt but that it will encourage the use of automobiles across the Bay, but will doubtless have very little effect on commuter traffic other than possibly to increase it should the bridge make it more desirable for some families to make their homes in Marin County.

Active interest is being taken in the construction of the San Francisco-Oakland Bay Bridge and some definite action may be taken at a very early date.

It has already been indicated that the increase in the number of industrial activities in the East Bay area has furnished employment to many on that side of the Bay. The major effect of this bridge will be to shift the point from which commuters enter and leave San Francisco. No definite conclusion has been reached as to the Bridge site and until this is done and the construction of the Bridge is assured, it is impossible to prophesy what effect this will have on the local transportation other than to state definitely that the removal of the East Bay commuter traffic from the Ferry Building at the foot of Market Street cannot but have a very marked effect on the Market Street traffic. It is more than likely that this shift will greatly improve Market Street traffic conditions, particularly if the blocks south of Market Street are modified as indicated in Chapter IV.

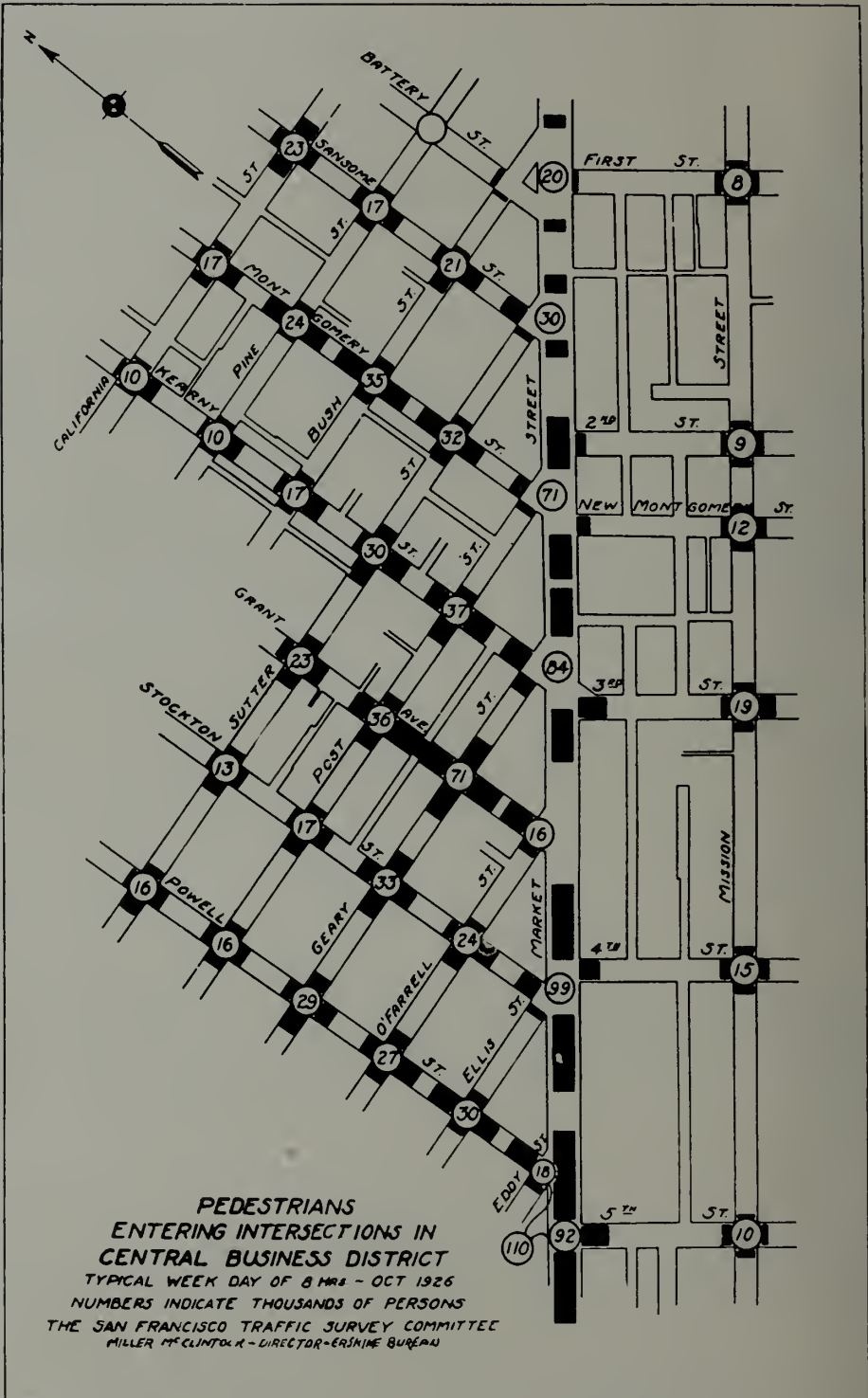


FIGURE 17.—NUMBER OF PEDESTRIANS AT INTERSECTIONS IN THE CENTRAL BUSINESS DISTRICT.

Heaviest intersections are on Market Street.

CHAPTER VI

DOWNTOWN TRAFFIC CONDITIONS

Pedestrian Traffic

A very important factor in the downtown traffic problem is the pedestrian movement. In figure 17 is reproduced a map from the report of the San Francisco Traffic Survey Committee showing diagrammatically the magnitude of the pedestrian flow through various street intersections in the central business district. This covers a period of eight hours of a week day in October, 1926. As only an eight-hour period is covered, the diagram does not give full effect to the volume of commuters walking to and from the Ferry Building.

It will be noted that the busiest intersections are along Market Street from Second to Fifth Street. This is due in a large measure to the necessary concentration of transportation facilities on this street. North of Market Street, the heaviest intersection is that of Geary Street and Grant Avenue where 71,000 pedestrians passed. The pedestrian movement at intersections on Mission Street is relatively small. In this connection it must be recognized that the volume of pedestrian traffic is a very important factor, fixing the value of sites for retail business purposes. Present values have been set by years of past experience, therefore they should not be unduly disturbed by any proposed changes in transportation facilities.

The street pattern of San Francisco's downtown area is such as naturally to cause a concentration of traffic on Market Street. No matter what other changes take place it is more than likely that Market Street will, for this reason, and because of its width, continue as the City's most important Street.

A heavy pedestrian flow at an intersection constitutes a hindrance to vehicular movement, particularly where turning movements are involved. The width of Market Street is such that appreciable time is required for pedestrians to cross and clear the street, which causes additional delay to street cars and other vehicles moving along the street.

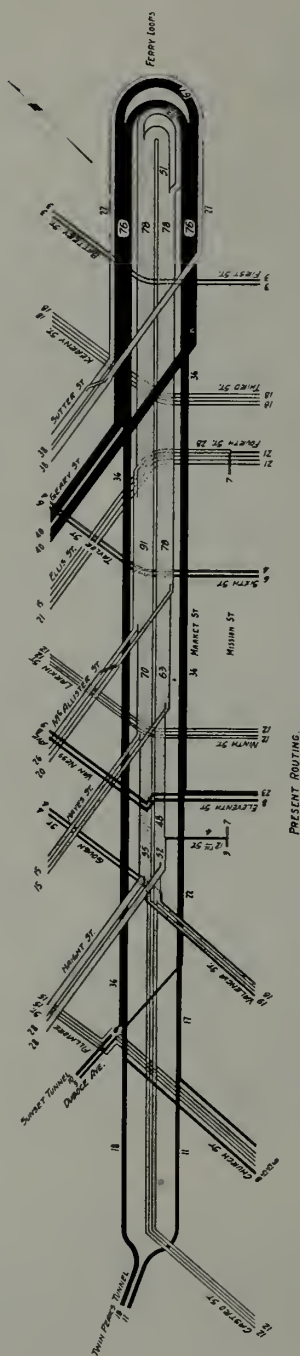
Anticipating the operation of suburban cars over the proposed East Bay Bridge, preliminary plans call for the construction of an elevated loop track for these trains south of Market Street extending as far west as Sixth Street. This would cause the present flow of commuters along Market Street to and from the present Ferry terminal to be diverted across Market Street to the various streets at which stations will be located. The resulting heavy cross traffic during rush hours may adversely affect vehicular traffic along Market Street, as already discussed in Chapter IV.

Street Car Traffic

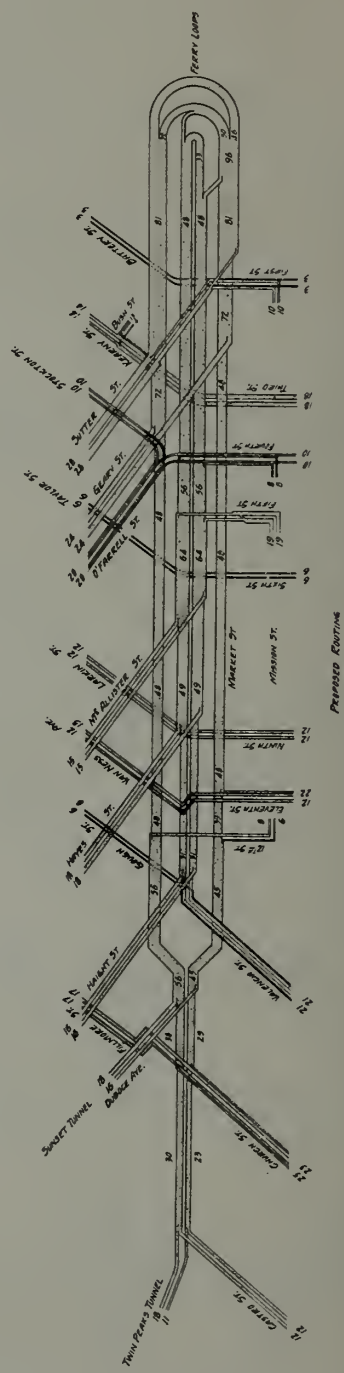
Plates 2, 3, 4 and 5 show details of traffic handled by the street cars in approximately the same district as covered by Figure 17. The data was obtained from checks made between October, 1928, and May, 1929.

Plate 2 shows the total number of street car patrons boarding and alighting from street cars in the downtown area, including transfer passengers. The diameter of the circle indicates to scale the relative importance of the intersection. The black portions of the circles show the number of patrons using the Market Street Railway lines and the dotted areas the number using the lines of

MARKET STREET CAR FLOW DIAGRAM
SHOWING CARS IN MAXIMUM HALF HOUR PERIOD 5:00-5:30 PM
IN ACCORDANCE STREET BUREAU REPORT
N.M. SHANNESSEY, CITY ENGINEER



PRESENT ROUTING.



PROPOSED ROUTING.

FIGURE 18. MARKET STREET CAR FLOW DIAGRAM.
Lower graph shows the effect of rerouting in accordance with the recommendations made in 1929.

the Municipal Railway. The outstanding intersections are Market Street at Third, Fourth, and Fifth Streets, and the Ferries. It is evident from this plate that relatively few people board and alight from the cars on Mission street except at Third Street, which is a heavy transfer point, being used by people from the Mission District going to the Third Street Station, or north on Kearny Street.

Plate 3 shows the actual number of passengers riding inbound on the cars through each section of the district. The width of the line indicates to scale the number of street car patrons. The areas in black represent patrons of the Market Street Railway and the dotted areas patrons of the Municipal Railway. It is seen that the block on Market Street between Taylor and McAllister Streets has the largest number of street car riders, the figures showing that 68,686 passengers daily rode inbound through this block.

Plate 4 is similar to Plate 3 except that it shows the number of outbound passengers on street cars within the downtown area.

Plate 5 was made by combining the data of Plates 3 and 4, and shows both inbound and outbound passengers on one chart.

A comparison of the number of passengers entering and leaving the downtown district by various streets furnishes an indication of their present relative importance with respect to railway transportation. Inspection of Plate 5 shows that the most important street railway tracks are, in relative order, the following:

1. Market Street	127,066	passengers
2. Geary Street	46,771	"
3. Mission Street	45,349	"
4. Sutter Street	38,919	"
5. McAllister Street	27,823	"
6. Third Street	26,553	"
7. Kearny Street	26,265	"

The number riding to and from the Ferry Building by various routes totals about 90,000 passengers daily.

Figure 18, which was taken from the report made by the City Engineer in 1929 entitled "Street Railway Transportation Requirements of San Francisco," shows the number of cars in the downtown district during the maximum half-hour period from 5:00 to 5:30 p. m. In the diagrams presented, the cars of the Market Street Railway and the Municipal Railway are separately identified. The lower diagram shows the effect of the rerouting proposed in that report and the resulting reduction in the number of cars operating on lower Market Street.

In the 1929 report a very extensive study was presented of the possibilities of improving street railway traffic throughout the City and on Market Street particularly. Any such plan is dependent on the unification of the street railway systems. The approval by the voters in November, 1930, of the plan to give the private lines an extension of franchise precludes the adoption of any rerouting which will relieve Market Street from carrying many unnecessary cars, especially during the shopping hours. The number of patrons to be handled during the morning and evening rush hours would require the retention of the four tracks even under unified operation as shown by the lower diagram of Figure 18.

At present the heaviest traffic is below the intersection of Sutter Street where 181 cars are handled to and from the Ferry during this half-hour period.

The next heaviest section is between Sutter Street and Geary Street where 167 cars are handled outbound and 154 cars inbound.

With the short headway necessary to move this large number of cars, the slightest interruption such as a minor accident, a fire alarm, or anything out of the ordinary, results in a delay of service for some time. It is not unusual to have ferry bound cars entering Market Street at Geary on schedule, and have them come back out of Market into Geary Street from ten to twenty minutes behind schedule. The average speed of cars on Market Street during the rush hour period does not exceed five miles per hour and for short distances it is sometimes possible to save time by walking rather than use the street cars. This has resulted in the railways losing some short haul business which they formerly enjoyed in the downtown district. Reference is again made to the time zone charts discussed in the previous chapter, Figures 13 and 14, which show in another way, the slow speed of operation on Market Street.

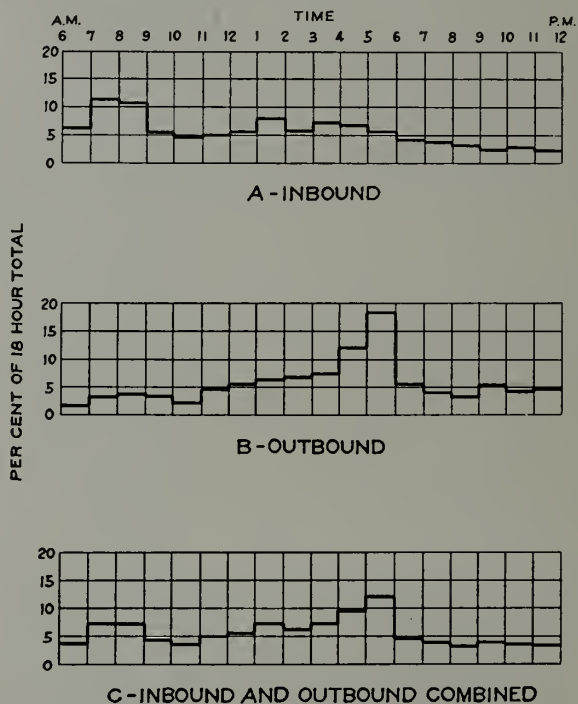


FIGURE 19.—DISTRIBUTION OF MARKET STREET PASSENGER TRAFFIC BY HOURS.

Average outbound traffic is only 31 per cent of the maximum.

Figure 19 presents three curves showing the spread of street car usage on Market Street during a period of eighteen hours. While the curves are based upon the traffic between Geary and Eddy Streets, they also apply very closely to all of the downtown portion of Market Street. Curve A indicates that the inbound peak occurs between 7:00 and 9:00 a. m., during which time the passengers handled per hour average approximately 11 per cent of the 18-hour total. The outbound peak is shown by curve B to be between 5:00 and 6:00 p. m. when 18 per cent of the total is moved. Curve C shows that the peak for the combined inbound and outbound traffic is between 5:00 and 6:00 p. m., when 12 per cent of the total is handled. If the traffic were uniformly distributed, 5.55 per cent would be

handled each hour. The load factor, or percentage ratio of the average to the maximum, is thus 51 per cent for the inbound traffic, 31 per cent for the outbound traffic, and 46 per cent for the combined traffic. As the number of passengers carried between midnight and 6:00 a. m. is practically negligible, these load factors would be reduced by one-third if based upon a full 24-hour week-day instead of the 18-hour period for which data was obtained. Giving effect to the lesser magnitude of Sunday and holiday travel would further reduce the load factor applying to the average day to about 33 per cent for the combined inbound and outbound traffic.

This figure is significant as indicating the degree of usage of the transportation capacity that must be provided. Thus, on the average, the investment here is productive only one-third of the time; this may be compared with a 25 per cent average usage common in metropolitan rapid transit systems. This factor is of prime importance in considering a subway project as the investment is large and the attendant heavy fixed charges are constant regardless of the degree of usage.

Motor Vehicle Traffic

Table VII shows the number of motor vehicle registrations, the annual increase, and the population per vehicle from 1914 to 1930. The annual increase has tapered off from 42 per cent in 1915 to approximately 2 per cent for 1930, while the population per vehicle has dropped from 32.3 in 1914 to 4.0 in 1930. It would appear from this that the number of persons per automobile is approaching a fixed number and in time the increase in the number of vehicles will follow the increase in population by a fixed ratio.

TABLE VII
SAN FRANCISCO MOTOR VEHICLE REGISTRATIONS

Year	Motor Vehicles	Increase Per Cent	Population Per Vehicle
1914.....	13,739	---	32.7
1915.....	19,513	42	23.4
1916.....	26,942	38	17.3
1917.....	33,990	26	14.0
1918.....	37,795	11	12.8
1919.....	49,507	31	10.0
1920.....	54,519	10	9.3
1921.....	62,683	15	8.3
1922.....	74,810	19	7.0
1923.....	89,539	20	6.0
1924.....	104,614	17	5.2
1925.....	115,726	10	4.8
1926.....	127,661	10	4.5
1927.....	135,100	6	4.3
1928.....	144,760	7	4.1
1929.....	154,519	7	4.0
1930.....	157,813	2	4.0

Apart from this it should be borne in mind that the amount of usage of motor vehicles will depend to a considerable extent upon the opportunities offered for use. With increasing congestion of the business area, it is to be expected that the individual vehicle on the average, will be utilized less and less downtown. As time goes on, additional restrictions of curb parking will be found necessary to better accommodate moving vehicles. Furthermore, it is not to be expected that

downtown storage facilities can be cheaply provided to keep pace with the increase in the number of vehicles which will have to be parked off the streets.

Because of the density of street car traffic on Market Street it has been necessary to prohibit movement of automobiles along the car tracks. Consequently with curb parking there remains but one lane in each direction for moving automobiles. A second lane cannot be opened as the density of pedestrian traffic prevents the widening of streets by cutting back the sidewalks. It has been necessary to prohibit left-hand turns on Market Street to avoid confusion at intersections. The above conditions have forced a large proportion of the motor vehicle traffic off Market Street and on to Mission or Howard Street. This results in additional mileage for the operators of motor vehicles, increases the total amount of downtown traffic and increases the cross traffic on Market Street.

On Geary Street, which has the heaviest street car traffic of any of the streets leading into Market Street, curb parking forces all of the auto traffic to use the street car lanes as shown in Figure 20. This naturally slows up all movement on this street to a very unsatisfactory extent.



FIGURE 20.—GEARY STREET, EAST OF LEAVENWORTH, MARCH 28, 1930.
Parking forces all traffic onto car tracks.

To show that rail borne traffic must be continued in spite of all claims to the contrary, it is only necessary to cite briefly the limitations of the automobile for moving passengers in quantities. Actual checks in eastern cities show that one car track has the capacity to move as many passengers per hour as twelve lanes of automobiles; thus the potential value of the four street railway tracks on Market Street is equivalent to forty-eight automobile lanes. Allowing ten feet for

each lane it would necessitate a street four hundred and eighty feet wide to accommodate the passengers which might be handled on the four tracks on Market Street. This shows the absurdity of expecting to benefit the traveling public by the elimination of rail transportation from Market Street.

Another feature worthy of notice is that the automobile itself requires for parking or storage, approximately the same floor area that is required by its user for work or business space. Consequently if all of the people entering the downtown district were to arrive by automobile, the space required for vehicle parking would approach that required for store and office space.

Actual count made of the number of purchasers in downtown stores arriving by automobile, shows them to be a small per cent of the total. Merchants of the downtown district cannot therefore place much dependence upon automobiles compared with mass transportation, to bring purchasers to their stores.

Parking Restrictions

Parking in the downtown streets adds more to traffic congestion than any one thing. It has already been pointed out that on streets other than Market Street, curb parking forces all of the automobile traffic to use the street car tracks. On Market Street it limits the automobile traffic to one lane between the outside street car track and the parked vehicles. A number of other cities have found it essential to the movement of traffic to prohibit parking altogether in the downtown area. Such an ordinance was placed in effect in Chicago a number of years ago and the amount of travel which was handled on the streets in the Loop District was materially increased without affecting in any way the retail business of the district. In fact, after the "No Parking" ordinance had been in effect for a year, the merchants of the district would have contested any attempt to repeal it. Records of two years' experience with no parking in the Chicago Loop District shows an increase of 29 per cent in the number of automobiles which were handled in the half hour peak. The increase in the speed of all traffic was from 15 to 40 per cent.

San Francisco has not as yet reached the point where it is necessary to prohibit parking entirely in the downtown district, but conditions would be vastly improved during the morning and evening rush hours, if the parking of automobiles were entirely prohibited on the major streets north of Howard, south of Bush, east of Eleventh Street and Van Ness Avenue, between the hours of 7:00 a. m. and 10:00 a. m. and between 3:00 p. m. and 6:00 p. m. Such a restriction would leave the five hours between 10:00 a. m. and 3:00 p. m. open for such shoppers and business people as desire to park in the downtown area. It would also leave the streets open after 6:00 o'clock at night for those who desire to dine downtown or attend places of amusement.

The arrangement of the blocks in San Francisco does not include alley space so that in most cases deliveries have to be made from the main streets. This makes it desirable that during the middle of the day, provision be made for such parking as may be necessary in the delivery of goods.

Rerouting

This report would not be complete without again referring to the matter of rerouting of street cars through the downtown district. This subject was very fully covered in the Report on Street Railway Transportation, issued in 1929, at which

time possible changes in routing were given in detail with the probable effect on the number of cars operated on Market Street.

By working out and placing in effect a system of rerouting, it would be possible to decrease materially the congestion of street cars in the downtown district. This would be particularly true east of Third and Kearny Streets, which is at the present time, the point of maximum congestion, resulting in several blocks of cars being held up each night at the peak hour.

The ultimate improvement to be obtained by rerouting will be impossible of attainment without unified ownership. There are, however, a number of changes which could be made through coordinated effort of the Market Street Railway and the Municipal Railway.

Mitigation of Congestion

On account of the street layout of San Francisco, Market Street is one of the most heavily used streets of the United States. The opening of a parallel street north of Market Street to relieve congestion is out of the question, yet some steps must be taken to secure relief. In the 1929 Street Railway Transportation Report a plan of rearrangement of street railways was presented which would greatly improve the conditions under which the street cars move. This plan of rerouting can not now be readily carried out since the private companies recently have been granted a twenty-five year extension of franchises, with no restrictions or incentive to force the unification of operation of the three systems.

The possibility of breaking additional north and south streets through from Howard Street to Market Street has already been touched upon. These streets would have a very appreciable effect on downtown traffic and would no doubt prove beneficial. They would add to the number of crossings of Market Street but would possibly not greatly change the time required to traverse Market Street as at a good many places there are already pedestrian crossings and crossings for traffic from the north of Market Street. The opening of these additional streets would have a tendency to change the concentration of traffic and would open up considerable territory south of Market Street for a better class of business than now utilizes this portion of the town. A number of interests would no doubt find considerable cause for argument pro and con as to the advisability of opening these new thoroughfares.

Study has been given toward constructing pedestrian subway dips under Market Street at the important intersections. The cost of these, together with a natural antipathy toward their use and the complications caused by bringing the necessary inclines up to the street level, render them unattractive.

Figure 19 shows the excessively heavy street car loading during the hour between 5:00 and 6:00 p. m. Any rearrangement of hours which would stagger the time at which employees of various business houses leave their work, would reduce the extreme congestion following the closing of business at five o'clock. Some of the downtown offices have already taken some steps in this direction but a sufficient number have not acted on the suggestion already made to secure marked relief. The same five o'clock rush which is experienced in the street has made itself felt within some of the office buildings in that the elevator loadings have peaked so sharply at five o'clock as to slow up the exit from the buildings. By breaking up the time in individual offices, this elevator peak is lessened as well as the crowds in the streets and on the street cars.

Again looking at Figure 19 it is seen that the morning peak does not at all approach the evening peak. This is due to the fact that people go to their work at a number of different hours while almost all leave at five in the evening. By proper cooperation from the various business organizations such as the Chamber of Commerce, Junior Chamber of Commerce, Retail Merchants Associations, etc., very much could be done to improve traffic conditions at no expense.

It has been suggested by some not versed in transportation matters, that relief can be obtained by substituting buses for street cars on Market Street. The fallacy of this lies in the fact that it would take three buses to replace one street car. Even if all other vehicles be excluded from Market Street, there would not be sufficient space on this thoroughfare to accommodate enough buses to carry all of the present street car passengers; some would have to walk and those fortunate enough to ride would have to make an additional transfer. The result would be a service far inferior to that now rendered and at a considerable increase in cost.

The only other way to relieve the unpleasant congestion is by enlarging the capacity of Market Street; obviously it is out of the question to increase the width of the street, therefore the only alternative is to increase the capacity by double decking the street, either through the construction of an elevated, or by the construction of a subway for the use of rail borne traffic. This method of enlarging the capacity of Market Street is discussed in the following chapters.



FIGURE 21.—FERRY TERMINAL, FOOT OF MARKET STREET, FEBRUARY 23, 1925.
Three levels used for traffic.

CHAPTER VII

RAPID TRANSIT REQUIREMENTS

Choice Between Subway and Elevated

The use of a subway or elevated is not new and has been very fully tried out both in the United States and abroad. Because of its relative cheapness, the original form of grade separation in this country was the elevated structure.

Riding on the elevated is much more pleasant than riding in the subway, but the appearance of the structure and noise of operation make it very undesirable. The erection of such a structure in a street interferes with surface traffic and darkens the street surface. The general experience with the elevated has been that when first introduced several years ago, it tended to increase property values. This is no longer true, and the present trend is for the elevated structure to hold property values down, if not actually to depress them. On the other hand, a subway increases property values, often considerably more than the cost of the subway itself.

The general reaction of the public toward the elevated has been such as to make it undesirable to consider its construction except under special conditions.

With the assistance of instruments developed by the Bell Telephone Laboratories, studies are being made to determine what can be done to reduce the noise created by railways. As yet it is too early to report any results from this work.

Initiation of Rapid Transit System

Just how much the size of a community has to do with the construction of subway lines is debatable. As a matter of interest there is tabulated below the population of a number of cities in the United States at the time they undertook their first rapid transit lines.

	Year	Population
New York	1870	950,000
Brooklyn	1885	710,000
Chicago	1893	1,215,000
Boston (Metropolitan)	1897	810,000
Philadelphia	1907	1,450,000

These figures indicate that population itself cannot be considered as the controlling factor. The important factor is, however, traffic density, which depends entirely on local conditions. San Francisco, with its business district in one corner of the area of the City, and with a topographical plan and street pattern such as to direct most of the downtown traffic through a narrow sector, will require traffic relief by means of rapid transit facilities at an earlier stage than some of the cities listed above.

Subway Dips

Many of the large cities are now studying ways and means of avoiding excessive downtown traffic congestion. No plans are being made for new elevated

lines but some cities are contemplating the construction of short sections of subways which will take off the surface a portion of the street cars normally routed through the center of the town. These street cars, which are of the ordinary type, will enter the subway on the edge of the downtown district and come back to the surface after having passed under the congested section.

Within the next few years, Chicago expects to spend approximately \$45,000,000 on a similar subway dip for use by elevated trains, and through north and south elevated trains being run underground under the center of town, continuing as elevated service both north and south of the Loop District. In this way the most pressing needs are cared for with a relatively short piece of subway, which under the best of circumstances is always very expensive.

In general, short sections of subway are so laid out as later to permit of incorporating them into more extensive rapid transit schemes planned for the future, which are not now feasible or desirable because:

(a) Long routes must be operated to secure the benefits of time saving.

(b) Traffic must be heavy enough to load trains operated at frequent intervals, otherwise advantages of rapid transit are lost through infrequency of service.

(c) Spacing of rapid transit lines and infrequency of stops makes its use less desirable than surface service under existing conditions.

A careful study of the present requirements shows no long routes which could advantageously be constructed in San Francisco at the present time. It therefore seems that San Francisco could best follow the practice recommended elsewhere by considering some means of traffic relief for the downtown district only. Whatever is done at this time must fit in with some comprehensive plan which not only cares for the present but the future also.

Comprehensive Plan

There has been laid out a tentative comprehensive plan of rapid transit routes within the City which is presented as Figure 22. This plan should be considered as tentative only, as many years will elapse before any such extensive system will be required and during that period many changes will take place which cannot be anticipated at this time and which will necessitate some deviation from any plan now proposed. It seems certain, however, that the downtown portion of the plan will be closely adhered to in any ultimate layout. In preparing this plan due consideration has been given to present routes of travel and the present development of the various sections of the City and the possible future trend of development. The routes have been laid out with a view to not developing one section of the City at the expense of other portions, and the arrangement is one which will permit of gradual construction as necessity demands and funds are provided.

The lines proposed are all feasible and run over routes having reasonable grades. Most subway construction is limited to a maximum grade of three per cent. It is difficult to do this in San Francisco where so many great differences in elevation are encountered and where topography and street pattern present other problems, which in many cases will prevent the construction of desirable lines and will necessitate deviation from the most direct lines possible.

On account of heavy surface grades it is impossible to construct rapid transit lines at a fixed depth beneath the surface and to attempt to maintain a

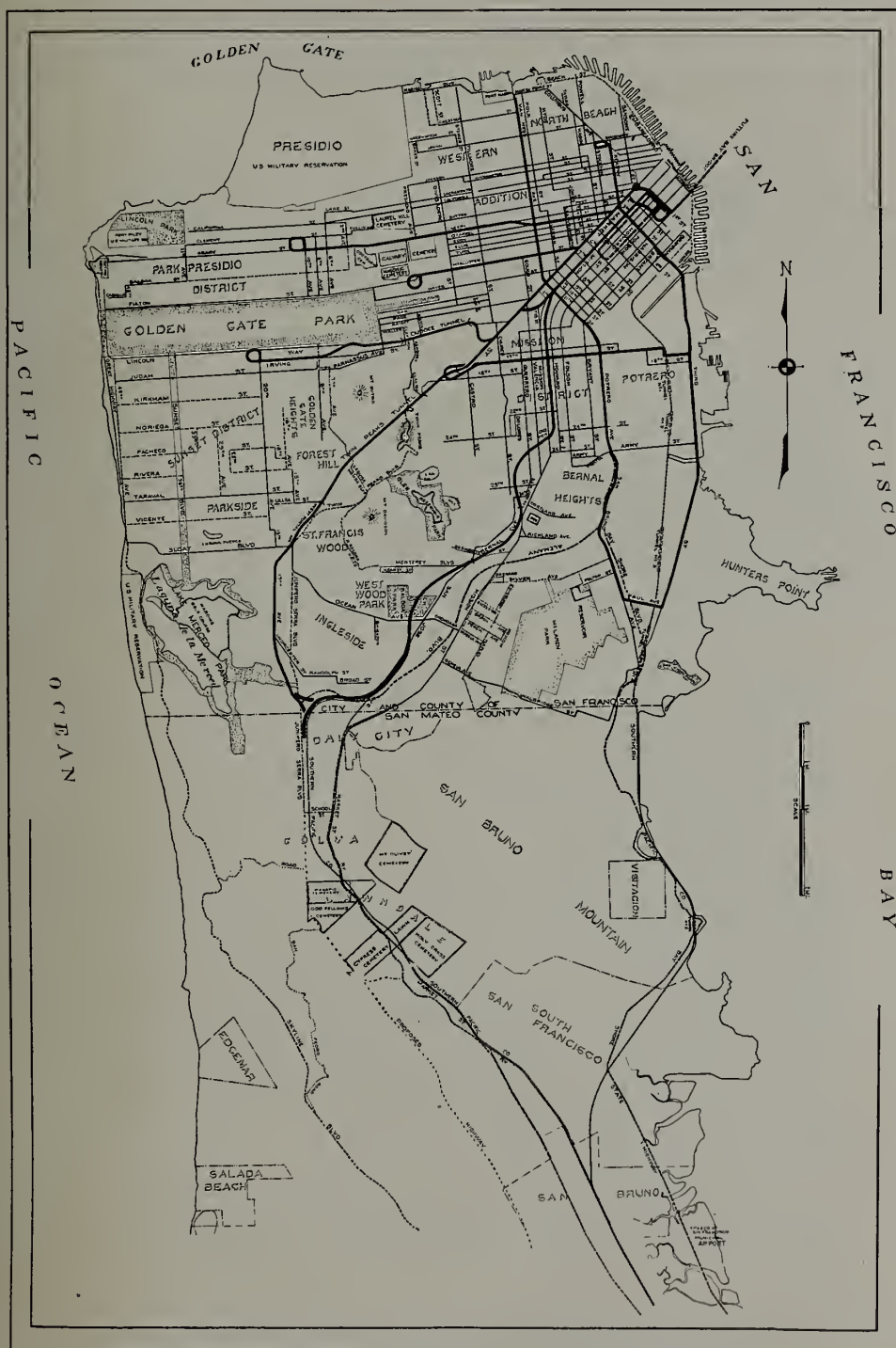


FIGURE 22.—COMPREHENSIVE PLAN OF RAPID TRANSIT ROUTES.
Several decades will elapse before such an extensive system will be needed.

three per cent grade carries the track either in subway so far below the surface as to be inaccessible, or in some cases overhead on viaducts, also out of reach. It has, therefore, in general been found best to stay with the already established lines of travel where the grades will not exact too great a toll from the rapid transit service.

The routes shown in Figure 22 consist of four routes reaching into the western part of the City, two routes in the northern section and three routes to the south, with a cross line running east and west. The construction of these will make the Richmond, Sunset, West of Twin Peaks, County Line and Bayview Districts as close in time to the business section of the City as some of the districts much closer in.

A brief description of each of the eight routes follows:

1—**Market Street Route.** Beginning at the East Bay Bridge terminal and extending to Market Street, thence under Market Street and through Twin Peaks Tunnel to the County Line, over the present Municipal Railway right-of-way as far as available. This will give direct transportation from the East Bay Bridge to all of the business district lying adjacent to Market Street and will connect Market Street with the west of Twin Peaks District.

2.—**O'Farrell-Geary Route.** This subway will connect with the Market Street subway at O'Farrell and Market and run to a terminal near the center of the Richmond District providing direct connection between this large section of the City and the downtown business district.

3—**McAllister Route.** This subway will extend from Market and McAllister Streets to a terminal in the vicinity of Masonic Avenue and McAllister Street and will provide rapid transit service for the large population lying between First Avenue and Market Street not reached by any other subway route proposed. The profile between Masonic Avenue and the Richmond District makes it impossible to extend this line farther without encountering excessive grades. The O'Farrell Street route will provide service for the Richmond District.

4—**Mission-Capp Route.** Commencing at the East Bay Bridge terminal and extending along Mission Street to a connection with Capp Street, thence along Capp Street to the Southern Pacific Company right-of-way, thence to Bernal Cut and along the Southern Pacific right-of-way to the County Line. This route as described is contingent upon the adoption of the proposal to widen Capp Street and the acquisition of the Southern Pacific Company right-of-way within the City. This route would be in subway to Capp Street widened, from which point an elevated structure of ornamental design would be used. Over the Southern Pacific right-of-way a portion of the route would be at grade and a portion elevated. This would furnish rapid transit service to the population of the Mission District reaching the downtown district and the East Bay Bridge. This route and Route No. 1 come together at the County Line and Junipero Serra Boulevard, from which point they can be connected to a high speed line reaching the Peninsula communities.

5—**Van Ness-Potrero Route.** From a terminal near Fort Mason this line would run along Van Ness Avenue, Eleventh Street, Potrero Avenue, San Bruno Avenue and Paul Avenue, connecting with Route No. 6. This is essentially a cross town route connecting with all of the other lines and giving rapid transit service to the north end of town.

6—**Kearny-Third Street Route.** From a terminal in the vicinity of Broadway and Stockton Street over Kearny and Third Street to the Channel underground, thence elevated along Third Street to connect with Route No. 5 at Paul Avenue. This would connect the downtown district with the growing industrial section and with the steam

lines operating to Peninsula points from Third and Townsend Station. Transfer connections are had with the Bay Bridge loop and the subways on Market and Mission Streets.

7—**Sunset Route.** Connecting with the Market Street subway near Church Street, thence through the Duboce Tunnel and into the Sunset District to a terminal in the neighborhood of Irving Street and Twentieth Avenue. This would provide direct service to the district south of Golden Gate Park to and from Market Street.

8—**Seventeenth Street Route.** This would be partly subway and partly elevated from Third Street over Seventeenth Street to the vicinity of Market and Castro Streets, connecting with Routes Nos. 1, 4, 5 and 6. This would establish a direct connection between the upper Market Street and Mission Districts and the industrial district along the Bay.

A line into the Western Addition, possibly over Fillmore Street and connecting with the Geary Street or McAllister Street lines seems desirable. On account of the topography, only a small part of this territory would be available to such a line. It may be found advisable to extend the line on Van Ness Avenue west, to touch the district adjacent to the Presidio.

This plan provides definite contact with the end of the East Bay Bridge but no provision has been made for connection with the Golden Gate Bridge which is not being built with tracks for electric interurban trains. Thus all persons arriving by this latter route will use either automobiles or buses which may be routed through the Presidio in such a way as to contact with one or more of the rapid transit routes proposed. As this bridge is now proposed, it will create no mass transportation problems.

CHAPTER VIII

INITIAL SUBWAY PLAN

Extent

It has already been stated that the logical initial step toward rapid transit construction in San Francisco will be the construction of a relatively short subway under Market Street to accommodate street cars in the downtown district, which will be, in effect, equivalent to widening that thoroughfare with none of the attendant inconveniences. In arriving at this conclusion, it has been borne in mind that in constructing the initial subway, it must be so designed that it may be utilized later for train operation at the minimum cost for changes to accommodate that class of service and at the same time must satisfactorily meet the initial needs.

Such a subway, while materially relieving surface traffic conditions, will not be as convenient for the ordinary user as the present street cars, as of necessity the stations will be spaced about a quarter of a mile apart, requiring many passengers to walk some little distance as compared with the present surface operated service where cars stop every few hundred feet and carry passengers to the crossing closest to their destination.

Market Street is without doubt the only logical location for such a subway and the initial development suggested is shown in Figure 23. This will consist of subway construction from First Street to Gough Street with branches at O'Farrell Street and McAllister Street.

Double tracks will enter the Market Street subway by an incline in the block just east of Valencia Street and will run under the center of Market Street to a point west of Sansome Street where they will again be brought to the surface by an incline. On McAllister Street just east of Hyde Street, two tracks will go underground and continuing to Market Street will take positions north and south of the two center tracks, making four tracks underground from McAllister Street east to Sansome Street. The outer tracks will continue to First Street where they will terminate in an underground loop. On O'Farrell Street east of Larkin, two tracks will go underground and connect with the two outer tracks on Market Street at O'Farrell Street.

In addition to the subway tracks there will be two surface tracks on Market Street west from Sansome and four tracks as at present on Market Street from Sansome to the Ferry, thus providing a total of four tracks on Market Street from Franklin Street to McAllister and six tracks from McAllister to Sansome, and four tracks from Sansome to the Ferry.

This rearrangement of the downtown transportation system will involve the following work:

Market Street

Remove four track surface line.....	9500 feet
Construct two track surface line	9500 "
Construct two track subway	5000 "
Construct four track subway.....	4300 "
Construct subway stations	6
Construct surface to subway inclines.....	2

O'Farrell Street

Remove and reconstruct two track cable line.....	2400 feet
Remove two track surface trolley line.....	1300 "
Remove one track surface trolley line.....	2400 "
Construct two track surface trolley line.....	2300 "
Construct two track subway	3600 "
Construct subway stations	2
Construct surface to subway incline	1

McAllister Street

Remove two track surface line.....	1000 "
Construct two track subway line.....	900 "
Construct surface to subway incline.....	1

Determining Factors

It is desirable that the reasons fixing the limits of the proposed initial subway be given. While Plate 2 shows very heavy passenger travel at the Ferry Building, this may be so reduced by the construction of the Trans-Bay Bridge as not to warrant subway operation to the Ferries. The East Bay Bridge is intended to replace the ferry service, therefore the subway should be designed to reach the bridge terminal. By stopping at First Street, the subway could be extended to the bridge terminal, at present proposed, with full utilization of all of the initial construction. This terminus also keeps subway construction on the solid ground as the old bay shore line crosses Market Street at First as shown by Plate 6. Construction east of First Street would be extremely expensive as all of it would be in filled ground requiring piling and under the level of the ground water. Proper use of the proposed loop at First Street would materially reduce the number of cars operated to the Ferry, thus avoiding congestion at that terminal and reducing the cost of operation. For these reasons subway construction east of First Street is not considered desirable at this time.

The westerly limit of the Market Street subway and the branches on O'Farrell and McAllister Streets were laid out with a view to taking into the subway as many car lines with as few portals as possible, at the same time providing for desirable future extension. The inclines connecting surface and subway tracks with their attendant protective walls, of necessity form an obstruction to surface traffic and therefore have been located out of the business district as far as is reasonably possible. These inclines will eventually be done away with when the subway lines are extended in carrying out the future program proposed. Branch tracks entering the four track construction on Market Street will be expensive to construct and costly and unsatisfactory to operate.

The number of branches has therefore been held to a minimum. In the future, the branches proposed in conjunction with the through service on Market Street will load the lower Market Street subway to its capacity.

In selecting the two branch subways to be initially constructed, consideration was given to Sutter Street, Geary Street and McAllister Street as being the three heaviest lines entering Market Street as shown by Plate 4. The other three lines coming into Market, namely, Eddy-Ellis, O'Farrell and Post Streets, do not carry sufficient business to warrant their being incorporated in the subway scheme. Under the plan proposed, Sutter Street comes into Market Street so near the end of the proposed subway, that it seems very logical to retain this as a surface line to the Ferry. A branch-off at Geary Street is not logical as the junction structure at this

point would interfere with the construction of a future subway across Market Street from Third to Kearny Street. It has therefore been thought best to shift this branch west to O'Farrell Street. By retaining a portion of Geary Street traffic on the surface and routing a portion of it through the subway, thence over to Geary Street, both long distance and short distance travel will be well taken care of. McAllister Street is the next best branch line.

By stopping the subway short of Valencia Street, it permits of routing cars off that street into the subway. For many years traffic on Market Street west of Valencia Street can be well handled by surface tracks.

Division of Lines Between Surface and Subway

In the following tabulation is shown a tentative allocation of the present lines between subway and surface tracks with the number of passengers at present leaving the central business district daily by each.

		Daily Number of Passengers Leaving Central District
Subway		
B	.....	7,900
C	.....	5,700
D	.....	6,000
J	.....	5,700
K	.....	6,700
L	.....	5,600
N	.....	6,700
5	.....	15,700
7	.....	4,800
9	.....	11,500
17	.....	4,700
Total	.....	81,000
Surface		
A	.....	4,300
1	.....	6,800
2	.....	7,400
3	.....	5,900
4	.....	7,300
6	.....	5,700
8	.....	5,900
21	.....	6,900
32	.....	1,400
Total	.....	51,600

This arrangement divides the cars in such a way that good local service along Market Street will be given on the surface and higher speed operation for the longer lines will be given underground. Experience in the operation of the subway will require adjustments of service from time to time so that both surface and subway service will operate at high efficiency.

Through the use of proper switching facilities at the eastern end of the subway, a considerable number of the cars using the subway can be turned back at this point, thus eliminating dead mileage between this point and the Ferry. A sufficient number of cars can always be operated through to the Ferry to give satisfactory service for those who desire to go beyond Sansome Street.

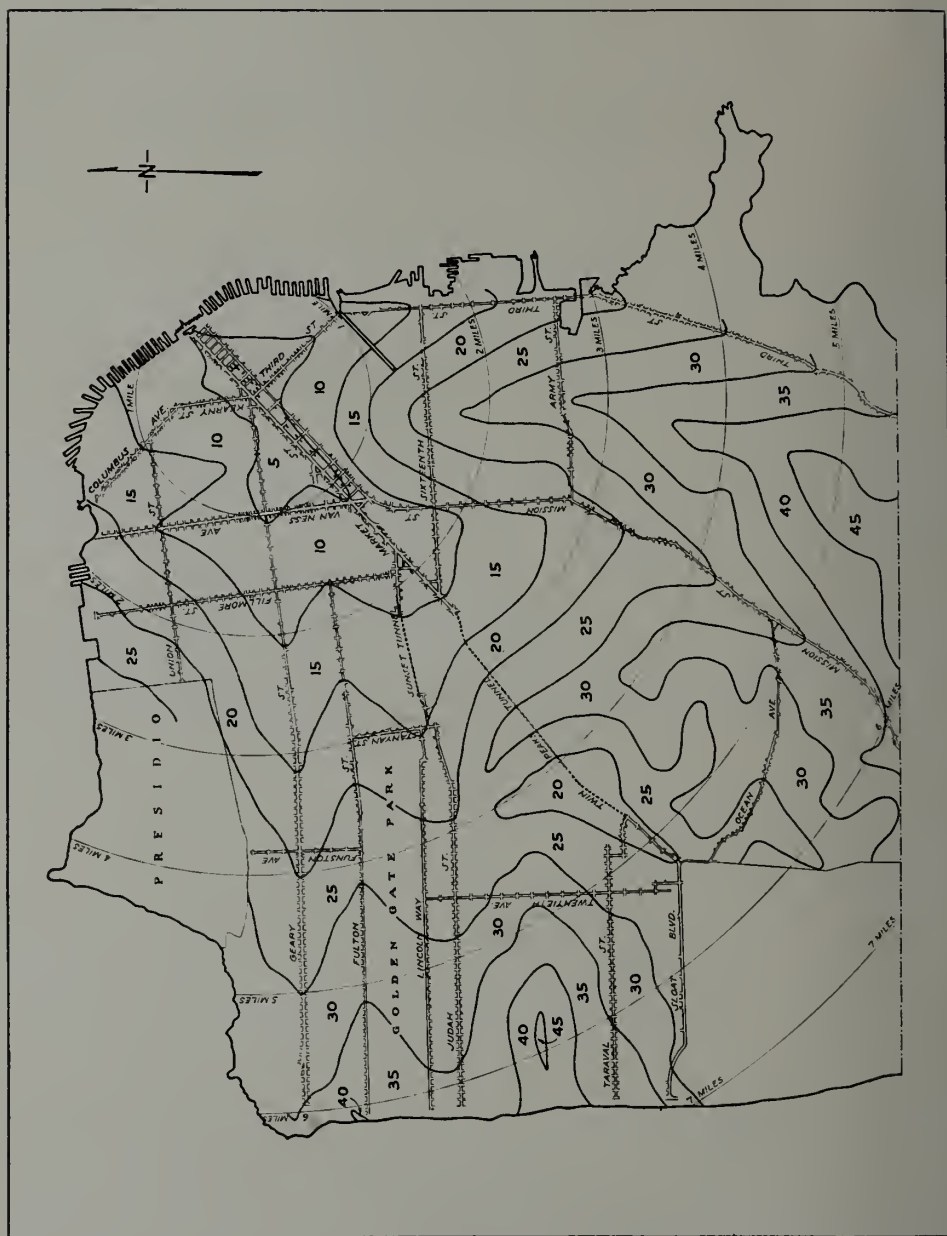


FIGURE 24. TIME ZONES FROM THIRD AND MARKET STREETS DURING P.M. RUSH, USING SUBWAY.

Station Arrangements

In order to secure ultimately the benefits of rapid transit, it is necessary to space stations about one-quarter of a mile apart, otherwise little advantage in time saving can be obtained over frequent stop operation on the surface. At the time the subway construction is undertaken, careful consideration will have to be given to the location of these stations. Any announcement of proposed subway station locations at this time would be premature and might result in unwarranted real estate speculation based on possible pedestrian traffic to and from these stations.

Saving in Time

It has been previously pointed out in this report that during the rush hour the street cars on Market Street run very slowly, not exceeding five miles per hour. Operating the present street car equipment in the subway, this speed can be increased to about fourteen miles an hour during the rush hour and to a somewhat higher speed at other times. Most passengers using the cars during the rush hour ride a considerable distance on Market Street. On the average, these patrons would be benefited by a saving of approximately ten minutes in time on the Market Street portion of their journey. Those accustomed to the slow travel on Geary Street would be benefited by the saving created by the subway on O'Farrell Street. Patrons of the McAllister Street line will benefit by the time saved on Market Street. The estimated improvement in traveling time is shown in Figure 24, which corresponds with Figure 14, showing time zones for present service. Figure 24 shows the time required to reach various points in San Francisco from Third and Market Streets with the subway in use. It is also suggested that a comparison be made between Figure 24 and Figure 15 showing time zones to various suburban points. Such comparison shows that the proposed short subway improves the running time to many of the outlying residence districts sufficiently to change the conditions brought forth under discussion of Figure 15.

The speed of the cars remaining on the surface in the downtown district should be increased to about seven and a half or eight miles an hour. These savings in time in addition to getting people home more quickly, will save many passengers from having to stand for a relatively long period in a crowded car during the rush hours, as it is impossible for any urban railway system to provide seats for all passengers during the rush hours. This improvement in traveling time and conditions, will no doubt prove a factor in attracting and holding people to San Francisco and should divert to the street cars, many now using automobiles, which will tend to improve downtown traffic conditions.

Surface Traffic

By reducing the number of tracks and the number of cars on the surface of Market Street, it will be possible to have at least two moving lanes of automobiles in each direction, making this thoroughfare an artery of considerably increased capacity for motor vehicle traffic. Placing cars underground and loading and unloading them at stations under the surface, and the use of mezzanine station floors as passageways between the two sides of the street, will take from the surface a considerable portion of the pedestrian traffic which now crosses on the surface. It is difficult to estimate just how much the Market Street traffic will be speeded up, but it seems probable that it can be increased by fifty per cent, possibly more, with the complete elimination of all parking during rush hours.

Co-ordination of Services

It must be evident from the discussion that the operation of the surface and subway tracks on Market Street and the ultimate operation of a complete rapid transit system is dependent on either unification of the City's transportation service or upon joint usage of the facilities and complete cooperation between the management and personnel of the rail systems involved.

In every big city where a rapid transit scheme has been carried out, the problems arising out of Municipal ownership of subways and company operation, have given more or less trouble. Chicago through its resettlement franchise, has had some control over the private organizations for many years past. This control still exists and the new plan which was approved in July, 1930, calls for the cooperation of the corporations and the City in improving transportation.

New York City is just now facing the problems arising out of what is known as their dual subway contracts under which the subways have been built by the City for operation by private corporations. Strenuous efforts are being exerted to bring the operation of the systems into the hands of the City of New York. The properties which will have to be acquired have values running close to one-half a billion of dollars.

The Market Street Railway and the California Street Cable Railroad are not so large but what they can be taken over by the City at this time. To do so would settle many problems which will otherwise remain to vex the future generations who will have to carry out extensive rapid transit extension programs. This assimilation of private companies can be done now much more readily than when they have put in many more millions of dollars in track and equipment.

In Philadelphia, the Philadelphia Rapid Transit Company operates elevated and subway trains on elevated structures and in subways belonging to the City. They also operate surface cars, buses and the taxicab service, monopolizing all of the transportation facilities in the City. Conditions have become such that Philadelphia is now considering ways and means for gaining control of the operation of the subways and elevated.

The indefinite continuation of three, or even two systems of transportation, is not in the City's best interests. The problem of unified transportation within the City has been under consideration for more than a decade and has not as yet been settled. It seems advisable to settle one railway problem satisfactorily before opening others for dispute and discussion.

The construction of the subway will necessitate removing from Market Street all of the existing surface tracks and the construction of a double track in the center. The center tracks are now owned by the Market Street Railway and the outer tracks by the Municipal Railway.

The plan proposed calls for the operation of all surface cars regardless of ownership, over the new surface and subway tracks. To put cars of but one system into the subway would only partly accomplish the results hoped for and would prevent the patrons of one of the systems from enjoying the full benefits of the quicker transportation.

On O'Farrell Street the changes will necessitate the cooperation of the California Street Cable Railroad Company which operates cable cars from Market Street to Jones Street and the Market Street Railway which has a single track trolley line west of Hyde Street.

If the private railway companies will not participate in the cost of removing the old tracks and installing the new, the cost will have to be included in that of subway construction. The companies will reap a considerable portion of the benefits through increased patronage, more rapid movement of cars through the downtown area, and the elimination of dead mileage east of Sansome Street, all of which will increase net earnings.

The maintenance of the tracks and of the subway itself and the operation and maintenance of the stations, are operating charges which should be jointly met by the systems using the facilities. Arrangements will be made in the design of the subway stations for the mechanical collection of fares at the entrance to the track level platforms. Passengers may then board cars at both ends without delay through picking up fares, which will materially decrease the length of stopping time and facilitate speed in the subway. Obviously where the cars of two systems run on the same tracks, it will be impossible to make any method of pre-payment accurately segregate the fares paid by the patrons of the two systems. This difficulty can only be overcome by approximating the division of receipts through an accounting agreement. With unified ownership and operation there would be no such problem.

Both the Market Street Railway and the California Street Cable Railroad, after the ratification of the Charter Amendment approved by the electorate in November, 1930, can obtain franchises covering all of their lines for the primary period of twenty-five years. Under the terms of the Charter Amendment the private companies cannot be required to part with any portion of their system, although the entire system can be purchased by the City at any time. This defect in the Amendment affecting subway construction, was pointed out at the time the Market Street Railway and Chamber of Commerce were drawing up the Charter Amendment but they refused to give the matter consideration. It was also called to the attention of the voters, who nevertheless approved the Amendment.

It is to be hoped that when the time comes for carrying out plans for the Market Street subway, that the managements of the private companies will cooperate with the people of San Francisco by participating in the expense to a reasonable extent and agreeing to an equitable division of the cost of the operation and maintenance. Failure to satisfactorily solve these problems in a manner equitable to every one, cannot but result in long delay in carrying out the proposed construction.

Transition to Train Operation

In order to secure maximum efficiency out of any type of rapid transit structure, it is necessary to use trains made up of several cars especially designed for rapid transit service. These cars are constructed without steps and must be loaded and unloaded at station platforms at the height of the car floor. It is impossible for passengers to board and leave such cars while on the City streets and equally difficult to load and unload street cars from the high subway platforms built to accommodate the rapid transit type of cars.

Whatever is constructed as the initial step of the rapid transit program should be designed with a view to its being readily changed over for train operation. The four track system which is proposed for Market Street, enables this transition to train operation to take place with the least possible expense and inconvenience. It is likely that the second step in subway construction will be to carry the system out Market Street and connect with the Twin Peaks and Duboce-

Sunset Tunnels. In this way the center tracks can be changed over for use by trains and the operation of the two outside tracks can be continued with the standard street cars. Later, when the necessity demands, and without again opening Market Street where four tracks had been constructed, the entire four track system could be operated by trains.

On account of the relatively short distances encountered in San Francisco, it does not at this time seem necessary to provide for express service for San Francisco, although if some lines are extended into San Mateo County, express service would be required on them.

In New York City, where four tracks are in use, the two center tracks are used for express service, making stops at intervals of from one to two miles, while the outside tracks are used for local service, making stops a quarter of a mile apart. The experience in New York has indicated that the operation of express and local tracks does not permit of the utilization of the full capacity of the four tracks.

There is no doubt but that the first step toward speeding up traffic in the subway here will be through the coupling up of street cars into two-car units. The present Municipal Railway cars can be rearranged for this service at very little expense. This train operation of street cars will quite likely take place on the heaviest traveled lines first. The use of two street cars in train service is now common in many places in the United States. On account of the grades in San Francisco it has been thought best to defer such operation until necessity demands it as the grades introduce certain complications not met with where the surface of a town is more nearly level.

Conclusions

After careful consideration of all local conditions, it seems that the initial plan of the subway on Market Street between First Street and Gough Street, best meets all the requirements of San Francisco's immediate needs. Through its use as proposed, all parts of the City now enjoying direct transportation to the downtown district will be benefited. The present arrangement of street car routings is not disrupted, although there is no doubt that some changes in routing could under any circumstances be made to improve local conditions.

The initial investment required is relatively small for a system that will really improve downtown traffic conditions for a considerable period of time and through the use of the present street car equipment, heavy expenditures for new equipment, new storage barns and new shops are saved.

As shown by the plan for ultimate rapid transit construction, the proposed subway fits into the plan for future development insofar as it is possible to predict at this time. The construction under Market Street will be built with a view to ultimate utilization with rapid transit trains. Any less costly undertaking would either not render satisfactory service, would fail to accomplish the desired results, or would necessitate again opening up Market Street and expending large sums of money at a later date.

CHAPTER IX

DESIGN OF STRUCTURES AND EQUIPMENT

In selecting the section of Market Street outlined for the construction of the subway, it has been necessary to give consideration to physical conditions. Primarily, it has been essential to consider the matter of sub-surface conditions as the kind of sub-surface soil encountered affects not only the difficulties experienced in excavating and constructing the subway, but also has considerable to do with the protection of the building foundations along Market Street during the time the subway is under construction.

Plate 6 is a geological profile of Market Street showing the materials which will be encountered under the surface. This shows that everywhere the proposed tunnel will be in sand. Attention is called to the fact that from First Street east to the Embarcadero the material which would be encountered in constructing a subway has all been filled in—the old shore line of the Bay crossing Market Street at First. This filled material is more or less soft and wet, or in such other condition as to make subway construction extremely difficult. The street elevation at First Street is 5.00 feet above City Base which is 6.7 feet above ordinary high tide, so that at any depth below the surface, the rise and fall of the tide in the Bay would be felt in the excavation. The fill was made gradually so that old piles and abandoned vessels are likely to be encountered in excavations as deep as would be required for the subway.

It would also be necessary to make some provision to properly support the weight of the subway structure. The buildings along this portion of Market Street are supported on pile foundations.

The conditions west of First Street are not at all unfavorable to the construction by the cut and cover method. This portion of Market Street is all sand on top of clay. The material to be gone through will call for heavy lagging and shoring, but presents no unusual or alarming difficulties.

The cut and cover method of construction is one most frequently employed and consists of opening the surface of the street and installing transverse steel beams on vertical posts sunk in holes or driven as piling. On these steel beams is laid a decking made of heavy planks which will carry the surface traffic while the subway space beneath is being excavated. On account of the peculiar layout of the City it may be necessary to provide some temporary arrangement for maintaining street car tracks on Market Street. Because of the width of Market Street the matter of maintaining the foundations of adjacent buildings will not be serious, although on account of the nature of the soil, it will require proper attention.

There are many pipes, wires, conduits, sewers, etc., under the surface of Market Street, all of which will have to be disturbed more or less. Figure 25 shows cross sections of Market Street at three different points and indicates the number of sub-surface structures in the business district. Some of these facilities can be supported from the steel beams carrying the deck and thus continue in service during the period of construction. The large sewers, many of the man-holes and transformer vaults, and the gas piping, will have to be removed and

reconstructed. Gas pipes have been the source of a number of explosions incident to subway construction in the East and will have to be removed to some safe location above the surface. No serious difficulty is faced in taking care of the service on the north side of Market Street and in many blocks no great difficulty will be found in taking care of similar service on the south side of Market Street. However, the job will require the full cooperation of the property owners and public utility companies concerned.

The opening up of Market Street to the extent required by the subway and the removal of two street car tracks will give the public service corporations an opportunity to rearrange their sub-surface facilities in such a way as to materially improve their systems. It is the intention to construct the subway at such a depth as to leave a minimum of six feet between the top of the subway structure and the street surface as a space in which to install all pipes and conduits normally required. New sewers will have to be built on each side of the street outside of the lines of the subway structure.

The construction of the subway will cause some inconvenience along Market Street but may be carried on in such a manner as not to interfere materially with business or the movement of traffic. Eastern cities have constructed miles of subway, some of which was completed in such a way as hardly to attract the attention of the casual passerby.

Subway Section

Many different forms of subway have been constructed in different cities, many of these forms being dictated by peculiar local conditions. Figure 26 shows typical sections of a number of subways and street car tunnels, also a proposed section for the Market Street subway. Cross sections of the Twin Peaks and Sunset Tunnels show them to be of the horseshoe shape necessary on account of the fact that they are tunnels subject to external pressure. Where the Twin Peaks Tunnel is carried under the Market Street Extension, it is a flat top section, similar in form to that proposed for the Market Street subway. This box type of construction is admirably adapted to construction by the cut and cover method where the flat roof design decreases the amount and depth of excavation. The inside height above the top of rail has been fixed at a minimum of fifteen feet in order to permit of the initial operation by means of trolley cars. Later operation by subway trains using a third rail will not require this height. Some of the New York subways are under thirteen feet from top of rail to roof beam. The new subway in Philadelphia has a height of fourteen feet as have some of the Boston subways.

The matter of subway ventilation is an important one. It is proposed to use the multiple compartment type of subway which not only gives the maximum strength for the minimum amount of material, but also provides for ventilation by the plunger action of the cars, each car forcing the air ahead of it. This construction will require fourteen-foot centers between tracks and an overall width of approximately thirty-three feet for the double track subway and an overall width of sixty-one feet where four tracks are operated in the subway.

Satisfactory construction can be had by the use of either reinforced concrete or by combined concrete and concrete encased steel construction. In the case of Market Street the latter is possibly to be preferred on account of the greater speed with which a length of subway can be completed.

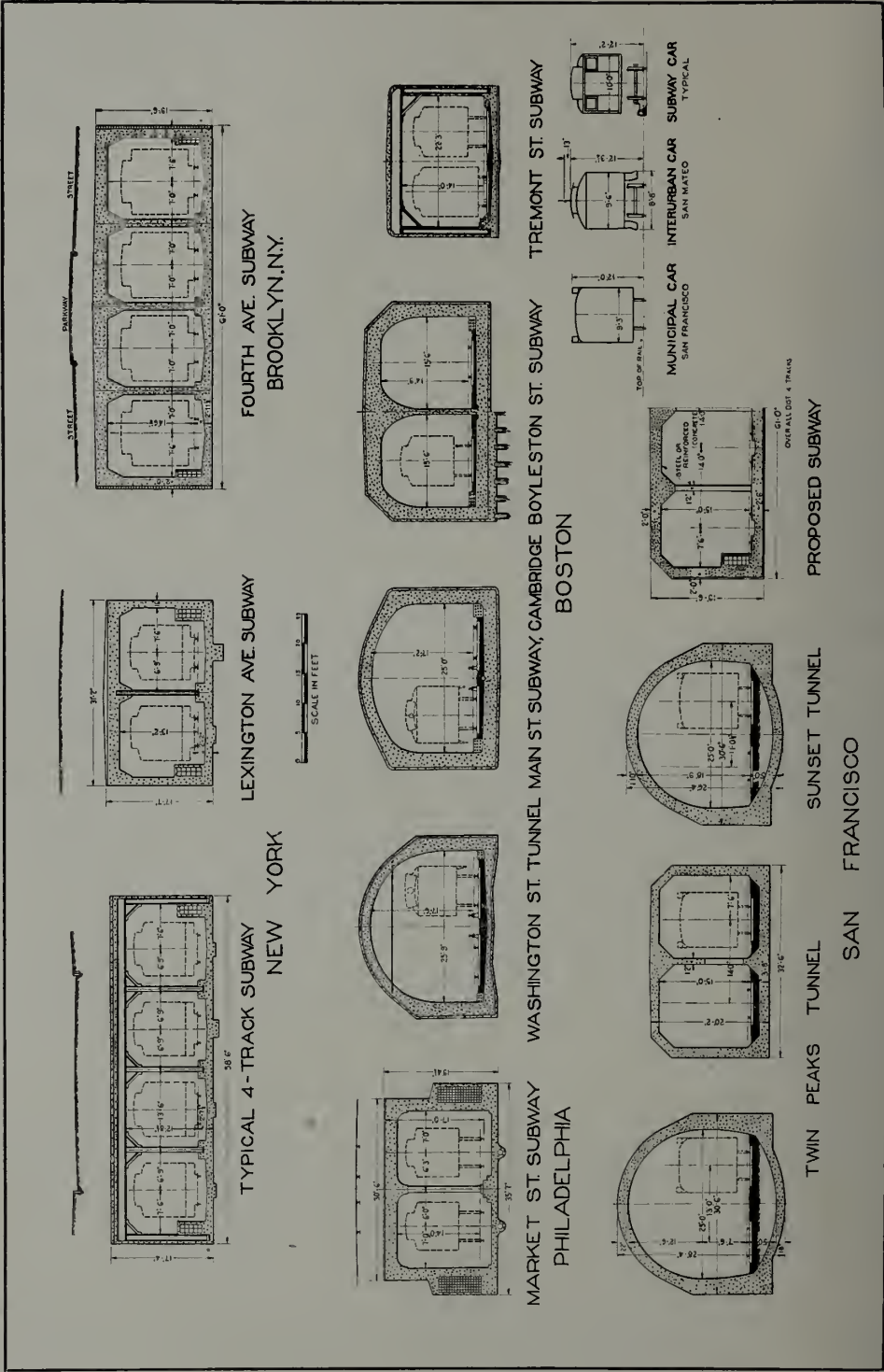


FIGURE 26.—PROPOSED SAN FRANCISCO SUBWAY SECTION COMPARED WITH EXISTING SUBWAY SECTIONS. Horseshoe section is necessary where heavy external pressures are present. The flat top section is most suitable for cut and cover type of construction.

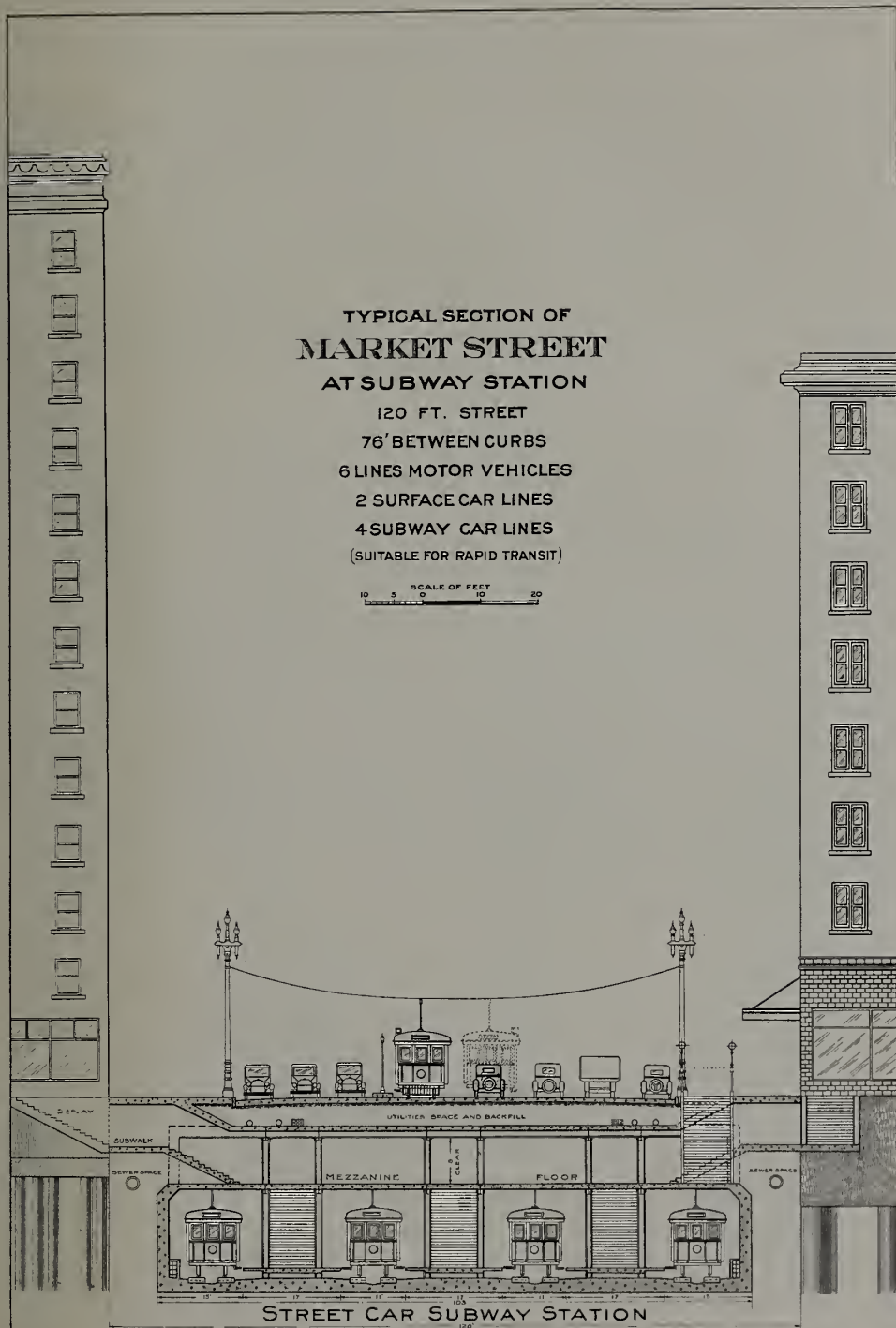


FIGURE 27.—TYPICAL SECTION OF MARKET STREET FOUR TRACK STATION.
The mezzanine floor serves as a concourse and will have show window space and building entrances.

Stations

On account of the street pattern it would be necessary to design each station individually to fit local conditions. A typical cross section of a four-track station suitable to Market Street conditions is presented as Figure 27. This figure shows the street surface with its traffic, the space for utility pipes and conduits, then a mezzanine floor which is connected by stairways with the sidewalk on each side of the street and with adjacent buildings if desired. From this mezzanine floor stairways lead down to the platforms placed between the car tracks at an elevation level with the car steps. This general arrangement has many excellent features to recommend it. The island platforms provide the maximum platform space with minimum overall width of excavation and avoid heavy expenditures for extensive underpinning of adjacent buildings. The mezzanine floor provides a passageway from one side of the street to the other and with relatively light expenditure on the part of the adjacent property owners, can provide individual basement entrances to adjacent buildings.

Figure 28 carries three sketches of various portions of a four track station arrangement. The upper one shows the entrance and exit gates and change booth on the mezzanine floor. The second sketch shows a typical arrangement of stairways leading from the space behind the entrance and exit gates down to the car platforms. The third sketch is of the level in which the cars operate. These sketches are only intended to be typical and do not indicate the exact construction which may be determined upon at the time the work is undertaken.

Figure 29 shows general plans of a typical four track station showing surface entrances, ventilating gratings and in dotted lines, pedestrian passageways underground. A longitudinal section is presented which shows the arrangement of stairways between the different levels. On the plan through the mezzanine floor the arrangement of the tracks on the track level is shown by their center lines, indicating how they will be spread to provide room for the platforms which are shown by dotted lines. The platform arrangement has not been finally adopted. On the mezzanine floor is shown a public passageway along each side leading to the entrance stairs. The sides of this passageway can be utilized by the adjacent merchants as additional display window space and entrances to store basements may be made at this level. Both of these privileges would be very valuable to business houses in the vicinity of the stations.

From this plan it is easy to see how passengers getting off cars can cross Market Street before coming to the surface, or can enter the station from either side of Market Street without having to cross on the surface. These passages underground can also be used by pedestrians to avoid crossing Market Street on the surface. The cross section is similar to that given in Figure 27.

Figure 30 shows the general arrangement proposed for the two track stations such as would be used on O'Farrell Street. It is very similar in general arrangement to the four track stations, except that it is necessary to use the full width of the street and loading platforms are provided on the outside of the tracks.

At each station, whether four or two track, it is desirable to assign stopping places for each line of cars using the subway, thus making it possible for passengers to go to some definite point on the platform to await the arrival of the car they desire to board. Such an arrangement will avoid a great deal of confusion and delay in loading. In Boston, on account of the layout of the station, it has been impossible to work out such a plan. This has very materially interfered with the full and satisfactory utilization of one of the important downtown subway stations through which street cars are operated.

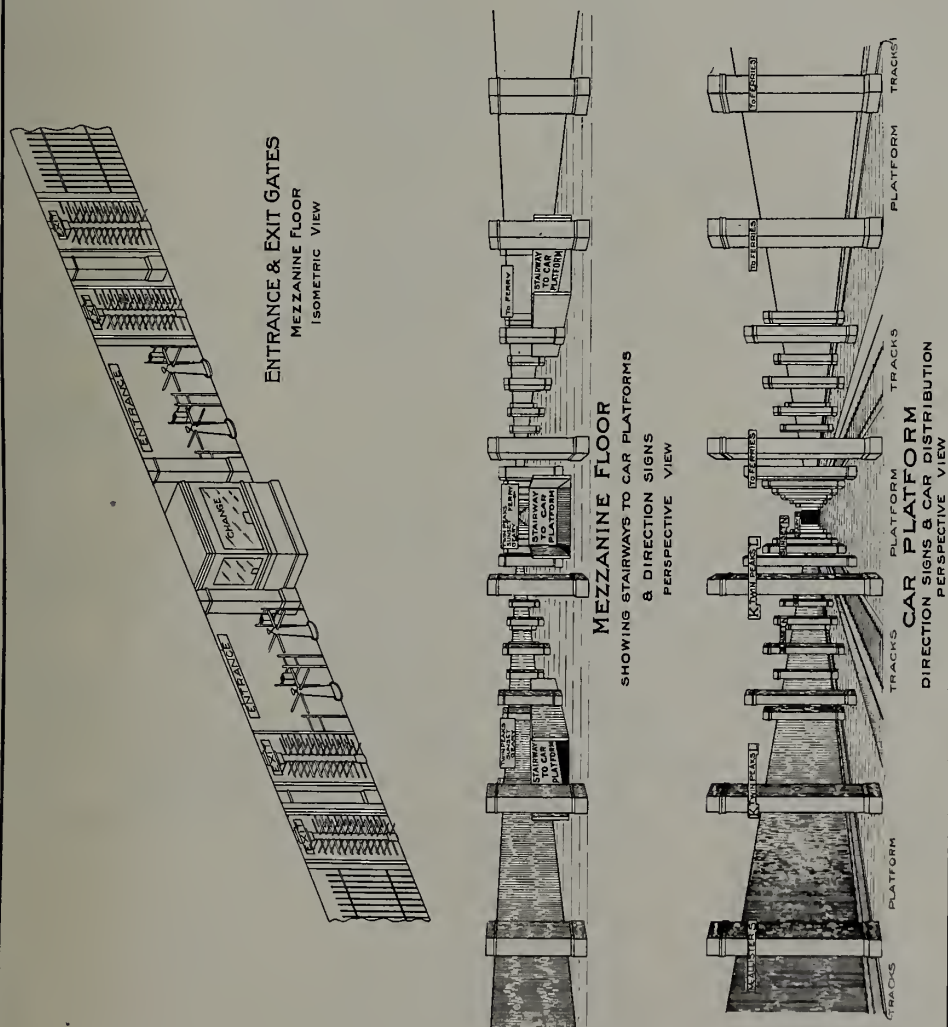


FIGURE 28. TYPICAL VIEWS OF FOUR TRACK STATION.
The prepayment gates are coin-released.

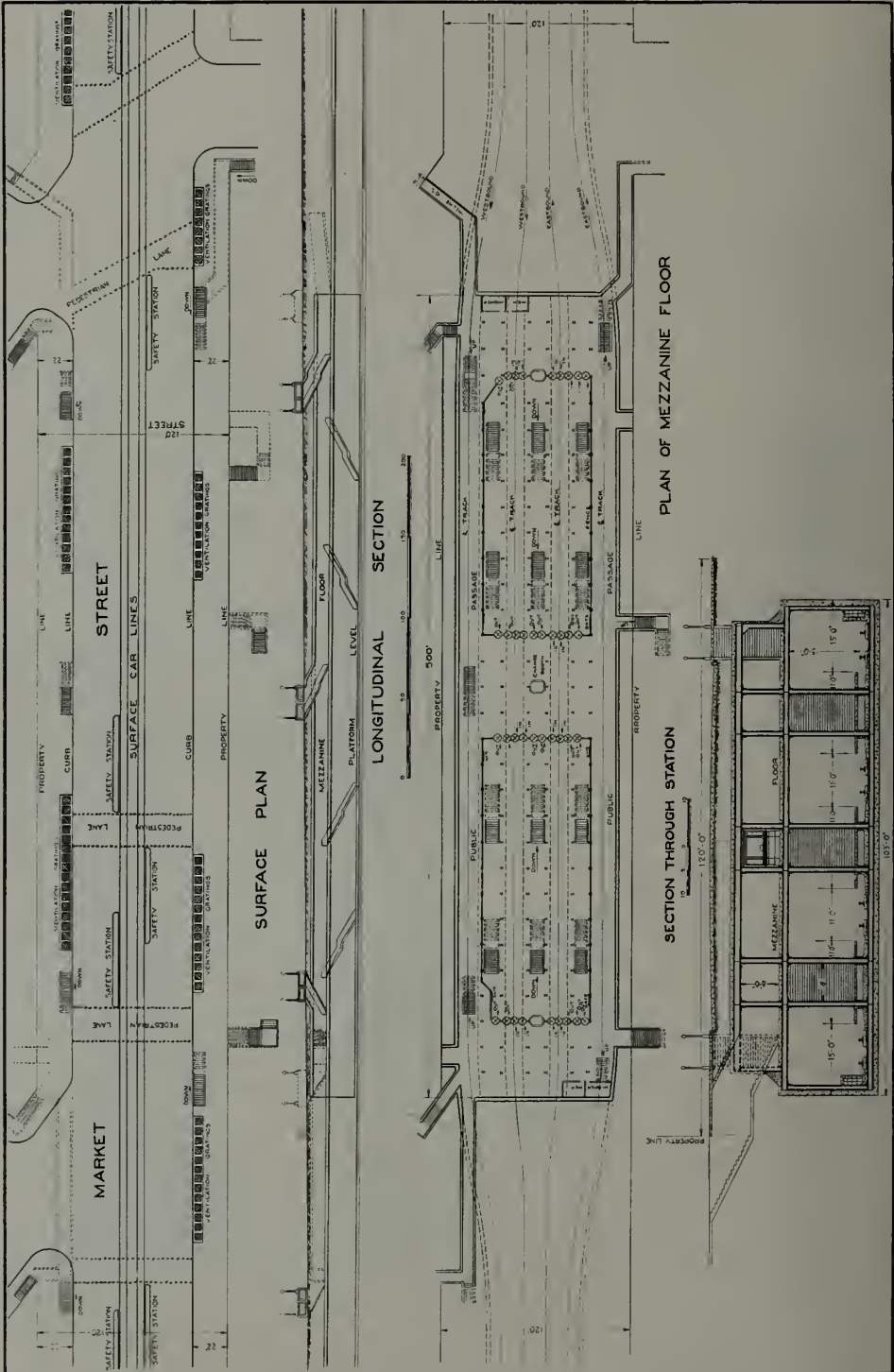


FIGURE 29. TYPICAL LAYOUT OF FOUR TRACK STATION FOR MARKET STREET.
This will be modified to fit actual street patterns.

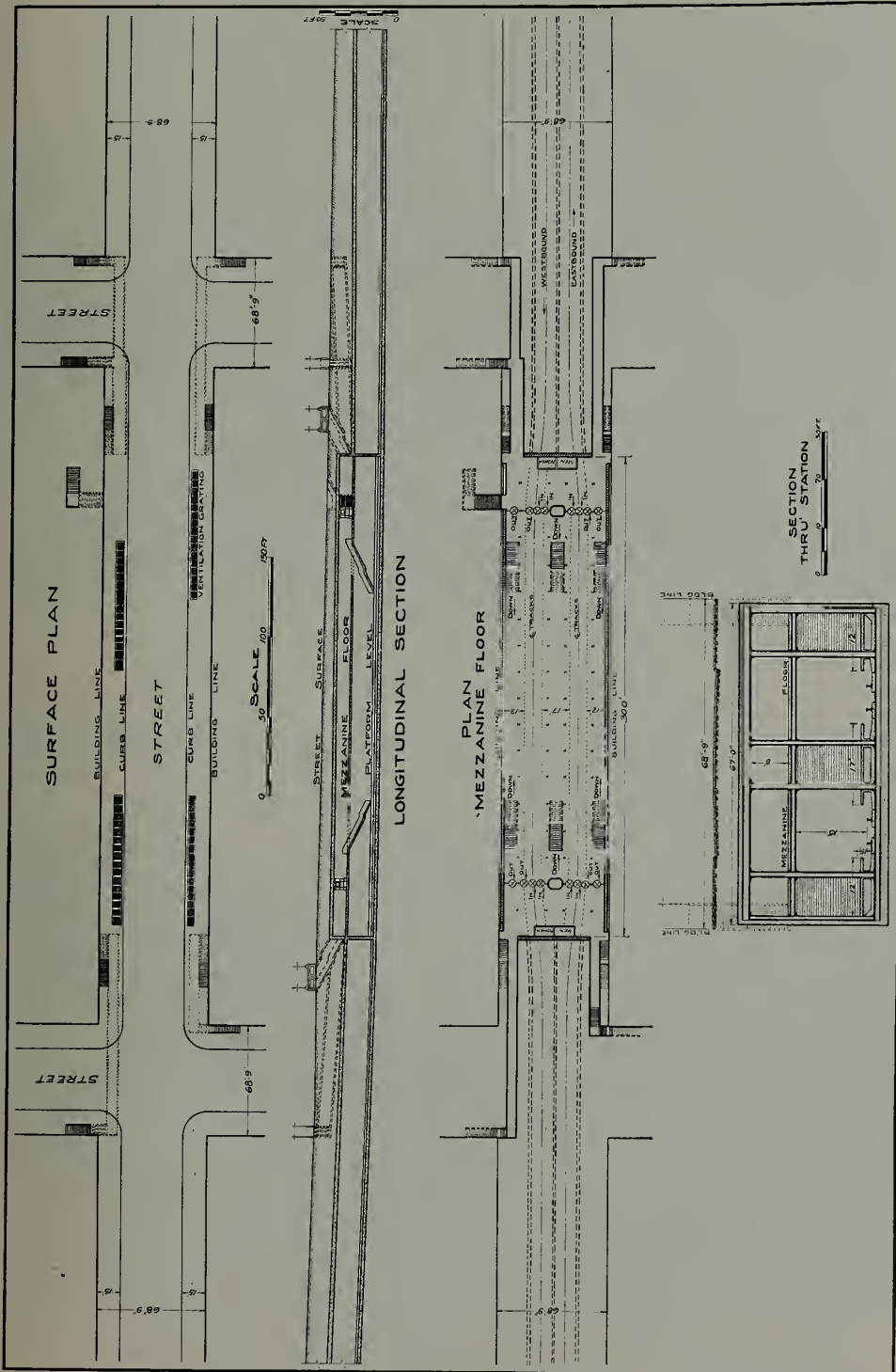


FIGURE 30.—TYPICAL LAYOUT FOR TWO TRACK SUBWAY STATION.

The stations will be constructed of concrete and steel. The walls and ceilings of the portions used by the passengers will be covered with a high grade glazed white tile trimmed with distinctive colors and patterns for each station so as to assist patrons in recognizing their destination point. Experience elsewhere with glazed white tile shows that its life is indefinite and that it can always be kept clean and presentable at a minimum cost.

The height of station platforms for the initial operation with surface cars will bring them opposite the lower step of the street car. These will be designed so that they can be built up to car floor height for use in connection with the rapid transit train operation when that service is planned.

Lighting will be by electricity, proper provision being made for emergency lighting in case the lighting service is interrupted. A mechanical ventilation system will be provided at each station to insure a generous supply of fresh air.

Station platforms, steps and passageways will have surfaces of slip proof material which can readily be kept clean.

The number of attendants required to operate a station of this character is very small. A passenger entering the mezzanine floor with the correct change for fare can pass directly to the car platform. Should change be necessary it may be secured at a change booth. Patrons may secure entrance by dropping their fare in the automatic electric turnstile which then operates to admit them. In addition to collecting the coin and admitting the passenger, these turnstiles record the number of passengers passing through the gate. The change booths and the turnstiles are so located that the booth attendant can supervise the operation of the turnstiles. Exit is had through other turnstiles so arranged that it is impossible to go back through them. This arrangement of pre-payment of fare does away with the collection of fare by car conductors or fare collectors on station platforms and materially speeds the loading of cars, at the same time reducing the number of employees required.

Inclines

Where the cars enter and leave the subway, it will be necessary to provide an incline track connecting the tracks in the subway with those on the surface. This will be done in open cut. This cut will be enclosed along three sides with a protecting wall of appropriate design. Four of these inclines will be necessary, one at each end of the Market Street subway, one where the cars come out into McAllister Street, and another on O'Farrell Street. Such incline entrances to subways are not an innovation as is shown by Figures 31, 32 and 33, which show three different portals now in use in Boston. Figure 31, which is taken from an elevation, shows a portal in the downtown section where it is necessary to carry surface tracks on each side of the portal. Conditions there are further complicated by the fact that there is a curve in the street at both ends of this incline. Figure 32 shows a similar incline in the residence district, while Figure 33 shows an incline in a narrow street with surface tracks on each side. These inclines will form an obstruction to surface traffic, and for this reason they have been located outside the congested district. When the subways are extended for train operation, inclines will no longer be necessary.

Equipment

For the initial step, it is intended to use the present trolley cars now in operation on the streets. Figure 34 is a drawing of the standard car used by the Municipal Railway. The general arrangement of the more recently constructed



FIGURE 31.—BOYLSTON STREET RAMP, BOSTON.
Boylston Street Subway. Loading platform at surface. Surface car track on each side.



FIGURE 32.—KENMORE STREET RAMP, BOSTON.
Boylston Street Subway. Incline located in parkway. Loading platform on incline.



FIGURE 33.—CAMBRIDGE STREET RAMP, BOSTON.
East Boston Tunnel Extension. Surface car track on each side.

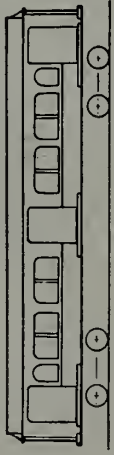
cars of the Market Street Railway is very similar. The entrances and exits to these cars have been designed primarily for operation on the surface where only a limited number of patrons will board or alight at a stop. In order to handle the larger number of passengers which will board these cars at the subway stations, some rearrangement of platform exit and entrance openings will have to be provided. It will also be desirable for safety reasons to provide some form of rear platform enclosure while operating in the subway.

The single car units used on the surface will doubtless be adequate to handle the traffic of the lines routed into the subway for a number of years. The speedier the service the more patrons and it is therefore likely that some of the lines could with advantage be used with two car units during the rush hour from the commencement of subway service. This will call for some further changes in the cars involving the installation of automatic couplers, changes in air brakes, and extension of existing remote control features on the Municipal Railway cars so as to permit of multiple unit operation. It has been thought wise not to consider replacing the present surface equipment with new rather than to make the modifications outlined, for the reasons that much of the present equipment can give excellent service for many years with a relatively low cost for remodeling.

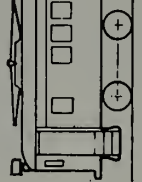
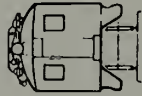
Figure 35 shows six types of cars used in both subway and suburban service in the New York Metropolitan District. The subway cars are built without steps and have from three to four doors on each side to facilitate loading and unloading. These doors are so spaced as to serve approximately equal lengths of the car. The interior of the car is designed with a view to quick handling of passengers. Cars for subway service have motors and gearing designed for a maximum speed above that which can be used on the surface.

SOME TYPES OF PASSENGER CARS
IN THE
NEW YORK METROPOLITAN DISTRICT

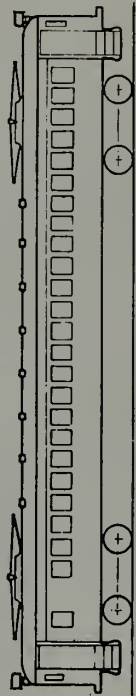
SUBWAYS



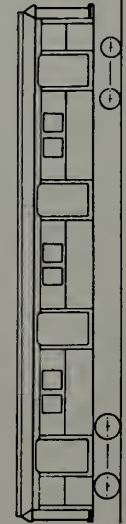
SEATING CAPACITY 44
LENGTH 51.00 FEET WIDTH 6.66 FEET
HEIGHT 12.00 " WEIGHT 74,000 LB



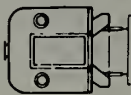
SUBURBAN RAILROADS



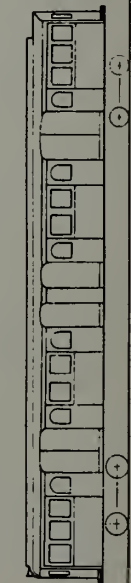
SEATING CAPACITY 120 3-2 SEATING
LENGTH 80.10 FEET WIDTH 10.05 FEET
HEIGHT 14.35 " WEIGHT 176,000 LB.



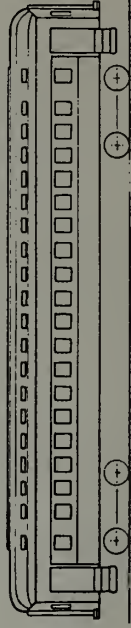
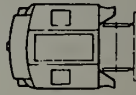
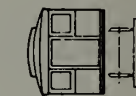
SEATING CAPACITY 60
LENGTH 60.21 FEET WIDTH 10.03 FEET
HEIGHT 12.16 " WEIGHT 85,000 LB



SEATING CAPACITY 78
LENGTH 63.48 FEET WIDTH 9.87 FEET
HEIGHT 13.89 " WEIGHT 117,200 LB



SEATING CAPACITY 78
LENGTH 67.20 FEET WIDTH 10.16 FEET
HEIGHT 12.14 " WEIGHT 94,000 LB



SEATING CAPACITY 78
LENGTH 72.17 FEET WIDTH 10.09 FEET
HEIGHT 14.24 " WEIGHT 113,500 LB

FIGURE 35—TYPICAL NEW YORK SUBWAY AND SUBURBAN CARS.
Subway cars are stepless and have extra doors.

Estimated Cost

The estimated entire cost of the subways suggested and the surface tracks for use in connection with the subway, is set up in the following Table:

TABLE VIII
CONSTRUCTION COST—INITIAL SUBWAY

Subway Structures	No. of Stations	No. of Tracks	Route Miles	Cost
Market Street Battery to McAllister	4	4	.94	\$ 9,450,000
Market Street McAllister to Gough	2	2	.83	4,300,000
O'Farrell Street Market to Larkin	2	2	.69	3,700,000
McAllister Street Market to Hyde	--	2	.17	750,000
TOTAL, Subway Structures.....	8		2.63	\$18,200,000
Real Estate for Widening Streets.....				1,000,000
Subway tracks, signals, distribution system.....				1,000,000
Surface tracks				1,000,000
TOTAL, Subway and Tracks.....				\$21,200,000
Equipment				
Changes to cars for subway operation.....				500,000
GRAND TOTAL				\$21,700,000

Detailed costs of subway construction in New York City, Philadelphia and Boston, together with the estimated costs of subways elsewhere, have been carefully considered in preparing the above estimates. This estimate, which totals \$21,700,000, covers the construction of 2.63 miles of subway, eight subway stations, the necessary tracks and auxiliaries, together with allowance of \$500,000 for changes in cars; the subways and stations alone cost \$18,200,000. A portion of this grand total cost is a proper charge against the operating railways as will be discussed in more detail in the next chapter.

The estimate which has been submitted covers the construction of the Market Street, O'Farrell Street and McAllister Street subways, but does not make any provision for an underground connection with the San Francisco end of the East Bay Bridge. As yet no definite plan for the Bridge has been agreed upon, which makes it impossible to lay out and estimate the subway requirements for the Bridge connection. By the time it is possible to proceed with the construction of the proposed subway, it is likely that a definite decision will have been made with relation to the Bridge terminal and the extension of the Market Street Subway to contact with the Bridge terminal should be included in the plans and estimates of cost for subway construction.

CHAPTER X

FINANCING

Those Benefited

In the previous chapters the benefits to riders have been very strongly stressed. It is true that the advantages to property along Market Street have also been touched upon, but in general the advantages have been shown to be in the way of increased speed of operation. The agitation for the construction of the subway, however, has come not from the riders, but from those interested in decreasing the congestion of traffic on Market Street. This leads to giving consideration to the classes of people who will be benefited from the construction of a rapid transit system through the congested part of the City.

From the standpoint of the car patrons there seems to be no question but that they would be satisfactorily served by some form of elevated railway. This operates in the open air and affords a view and altogether provides much more comfortable transportation. From the standpoint of the property owner, however, an elevated on Market Street and into the downtown district is entirely unthinkable, as it would without doubt greatly depreciate property adjacent to the elevated structure. From the standpoint of the automobile driver, the elevated structure would place many obstructions in the street and make the roadway much more unpleasant to drive over. Stated in concise terms, those interested in subway construction are:

1—Patrons of the railways using the subways.

2—Property owners adjacent to the rapid transit line whose real estate, improvements and business will be directly benefited by the subway construction.

3—The general public of the entire City who will be benefited by the improvement in downtown conditions and because of the increased desirability of San Francisco as a place of residence due to improved transportation.

4—The motor vehicle owner and operator who will be provided with more space and better driving conditions in the downtown streets.

If the first three classes participate in the cost of the construction, it is impossible for the last named class to escape as the first three classes under present conditions, embrace the fourth.

Division of Costs Elsewhere

The problem of allocation of subway costs has had to be met elsewhere and the following shows some of the methods employed. It is self evident that local conditions must be considered in dividing the cost between the various classes.

New York City. All subways have been constructed by the Municipality. The first of these were leased to the railway companies on terms which provided interest and sinking fund charges on the subway investment. Increases in operating costs and the cost of railway construction has made it impossible for the railways to earn these charges on the five-cent fare. Consequently the people of New York are raising through taxes, approximately \$13,000,000 per year for subway fixed charges in order to retain the five-cent fare, which is equivalent to subsidizing the railways operating in the subways by this amount. New subways are being built in New York at a very rapid rate, their recent budget calling for an expenditure of \$140,000,000, which is more than the entire funded debt of the City of San Francisco.

Boston. The subways are constructed by the City under control of the State and leased to the Boston Elevated Company at a rental sufficient to meet cost and sinking fund charges. The fare in Boston is regulated to permit the railway to earn these charges.

Philadelphia. The subways and some elevated lines are owned by the City and the service is operated by the Philadelphia Rapid Transit Company. Only part of the cost and sinking fund charges are carried by the lease holder. The Transit Company has only been able to contribute a very small amount toward the fixed charges for the new Broad Street subway. This subway cost \$100,000,000 and for the first three months beginning with September 1, 1928, the company paid \$200,000 per month, which they found could not be carried out of the receipts from the service, necessitating a very much smaller payment since January 1, 1929. Thus the burden of the losses is borne by the taxpayers.

St. Louis. St. Louis has no rapid transit service but in its study has proposed that the operating company pay for the cost of the tracks, the cars and electrical equipment, the City at large to pay 25 per cent of the cost of the subway structure, 75 per cent to be paid by the benefited property owners.

Detroit. There is at the present time no rapid transit system in Detroit but it is proposed to construct a subway, the total cost of which, including cars, track and electrical system, would be charged 32 per cent to the transportation system, in this case owned by the City, 51 per cent to the benefited property owners, and 17 per cent to the City at large, the benefited assessment being levied on the property within one-half mile of the line.

Chicago. The Chicago Elevated System is privately owned, likewise the Chicago Surface Lines, which many years ago were granted an indeterminate franchise under which the City was given some say in the control of the property and received 55 per cent of the net revenue of the surface lines. From this source over \$61,000,000 has been collected. It is now proposed to expend this sum with additional money, to be raised by assessment from benefited areas, without recourse to general taxation, in the improvement of the downtown portion of the rapid transit service, including improvements to equipment and existing elevated structures.

Street Railway Financial Status

The report of 1929 on Street Railway Requirements very clearly showed that the street railways of San Francisco are not earning sufficient on a five-cent fare to permit them to continue rendering the present service without help from some quarter—either an increase in fare, or as proposed for the unified system under Municipal ownership, a subsidy through taxation. Since the rendering of this report, there has been a continued slow decline in the railway revenues.

Street Railway Participation

It is therefore evident that under present operating conditions neither the Municipal nor private street railways are in a financial condition to bear additional costs due to the construction of a subway, without raising the fare. It seems unjust to increase the fare of all lines because a few of them are to use the subway.

There are, however, some benefits which will come to the railways by reason of the construction of the subway which will increase the net revenues. An estimate of the annual decrease in number of car hours required to produce the same service as is now being given is as follows:

Cars using Market Street Subway.....	406,000	car	hours
Cars using McAllister Street Subway.....	67,000	"	"
Cars using O'Farrell Street Subway.....	114,000	"	"
Cars using Market Street Surface Tracks.....	55,000	"	"
TOTAL	642,000	"	"

In round figures it may be estimated that the above saving in car hours could increase the net revenue by a million dollars per year. There are, however, some additional operating expenses to be incurred by reason of the use of the subway. The stations will have to be lighted, maintained, and some employees will be required to be in attendance throughout the twenty-four hours. The additional labor costs will be partly offset by the saving in wages of inspectors and collectors who now have to be maintained on the street surface.

In view of the savings set forth above, and on account of the increased business which should flow to the railways, it seems only just that they should pay sufficient rental to cover maintenance and operating costs of the subway, and in addition at least a portion of the fixed charges on the tracks and electric system, but no charges on the subway structure itself. The railways should also carry the entire expense of modifying their cars for use in the subway.

Through the City paying for the track and power construction in the subway and making a lease agreement with the railways by which they will meet the maintenance costs and fixed charges, it will be possible to overcome a number of the obstacles in the way of joint operation which are brought about through the dual ownership of the railway systems. It by no means solves all the problems, but with the City holding title to the property, it is possible for the City to collect from the railways on the basis of usage. It also makes it possible for both lines to use the surface tracks without question of ownership. By this method of procedure, the cost of operation, maintenance and perpetuation of the railway property is passed on to the patrons of the railways.

With the railways using the subway under a single ownership, it would be possible to require the railway to arrange for the financing of the original cost of making the installation of track and auxiliaries, and bear the burden of operation and maintenance.

Against my recommendation, Charter Amendment No. 35 was approved by the electors last November. This has allowed the railway to extend most of its franchises for a period of twenty-five years, thereby tying the hands of the Municipal Administration to the extent that the consent of the Market Street Railway must be obtained before inaugurating any extended program of improvement in transportation within the City.

Participation by Adjacent Property

Elsewhere assessments have been planned in such a way as to place the major portion of the cost of subway construction on the property benefited. In the case of St. Louis this has been shown to be 75 per cent of the cost. In view of the fact that the subway proposed is to benefit the City at large through improving Market Street traffic conditions and speeding up street car service through a large section of the City, it seems just that the property adjacent to the subway should not bear this high percentage of the total cost. The construction will be such that it can later be converted to a train operated system at which time additional expenditures will have to be made. It is also true that the same area served by the Market Street subway will later have to participate in the cost of the subway on Mission Street, on Kearny Street and on Third Street. Under these conditions to assess 50 per cent of the cost against the adjacent property seems equitable.

Participation by the City at Large

The tax payers of the City of San Francisco include the automobile owners and all of the property owners who will be benefited by the generally improved condition created through the construction of the downtown subway, and they should gladly bear one-half of the cost of the subway construction.

These three divisions of the cost are, namely:

- 1—Expenditures for track, trolley and allied accounts to be made by the City but to be carried by the street car users through lease contracts with the operating companies.
- 2—50 per cent of the cost of the subway to adjacent property by assessment.
- 3—50 per cent of the cost of the subway to the City in general through taxation.

Public Utility Costs

Another item of cost of subway construction not heretofore touched upon is the expenditure which will have to be made in caring for and rearranging the facilities already in the street. These consist of the City's sewers, high pressure fire system, and fire alarm and police communication systems. The cost of taking care of these Municipally owned properties is a legitimate part of the subway cost.

In addition to these in the streets which will have to be opened, there are electric, gas, water, telephone, telegraph, heat, messenger service and tube systems, all belonging to private corporations. These owners are revenue collecting utilities and it is equitable that they be required to pay a portion of the costs without throwing an unnecessarily heavy burden on the users. It is suggested that this be done through reimbursing the utilities for the value of the facilities now in use, which will have to be abandoned, this value to be original cost less depreciation and salvage. This procedure would protect the investment of stock and bond holders and leave the way clear for the companies to replace the old equipment with entirely new facilities, charging the cost to capital account. This is an equitable way of handling the matter as the companies lose nothing through taking out the old facilities and there is no question but what they would be greatly benefited by being able to install modern well designed facilities laid out to meet existing and future conditions. The operation of the newer facilities would doubtless be cheaper than continued use of the present ones. The companies should willingly meet the costs of temporary service in view of the benefits which they will ultimately gain.

The protection of the capital of the street railways is similar except that the railways lose some of their property as they will not be required to replace it after completion of the subway. Both the Market Street Railway and the Municipal Railway will be required to abandon a double track railway within the limits of the subway construction. This is because it is proposed that title to the new tracks in the subway and on the surface be held by the City. To offset this loss, both systems will be relieved of the expense of maintaining a considerable amount of pavement and through the ability to turn cars back at First Street, be able to save a considerable amount of otherwise dead mileage.

These two savings are in addition to the savings in car hours already given, as those figures were based entirely on increased speed. Some equitable means of reimbursing the railways for the property lost on the basis of original cost less depreciation and salvage should be made, including consideration of the ultimate savings to the railways through the use of the subway.

Allocation of Costs

In the previous chapter, it was estimated that the total cost of building the initial subway system would be approximately \$21,000,000. Dividing this sum equally between the property owners and the City at large, makes the share of each \$10,500,000. The sum to be raised by assessment would come from an area of approximately 15,000,000 square feet of assessable land, or at the rate of seventy cents per square foot. This same property has approximately 175,000 feet of street frontage excluding alleys. Dividing the cost on this basis would require an assessment of \$60 per front foot.

As to the raising of the \$10,500,000 from the City at large, there is much to be said in favor of adding \$1,050,000 a year to the tax rate for a period of ten years. As it will require seven years to carry through the subway program, 70 per cent of the cost could be raised directly and some satisfactory means of securing the remaining 30 per cent prior to its receipt through taxes could no doubt be arranged. On the basis of an assessed valuation of a billion dollars, the tax rate would be increased ten and a half cents. Interest charges for the 30 per cent not collected prior to the completion of the project, might increase this rate to twelve or thirteen cents for the last two or three years.

The other method of raising this money would be by issuing bonds payable over a number of years. Should this period be forty years, interest and retirement charges at the beginning would be at approximately seven and a half cents, gradually decreasing to about two cents on the tax rate at the time the bonds are finally retired. However, it seems undesirable to pass the burden of constructing this subway for our immediate benefit on to posterity, when the next generation will of necessity be faced with their own burdens incident to extending rapid transit service.

In the abstract, the assessment charges against adjacent property may seem large but are really small when compared with the value of the property and the enhancement in value which will accrue through the construction of the subway. In New York City the advance of property values adjacent to subway lines has been from 5½ to 7 times the cost of construction. Under similar conditions, except where the district benefited bears 50 per cent of the total cost, the property value enhancement would be from 11 to 14 times the amount paid. The increase in value of property through the construction of rapid transit lines has not been confined to New York City only, as similar improvements in real estate values have been experienced everywhere that subways have been built. It is certain that most of those paying assessments for subway construction in the downtown district of San Francisco will experience increases in real estate values more than offsetting their assessment.

At the present time there is no legal procedure under which assessments can be made for the downtown rapid transit subway, although such procedure exists for making assessments for tunnels, such as the Twin Peaks and Duboce Tunnels. It will therefore be necessary to have the procedure prepared by the City Attorney. This can become effective by being incorporated in an ordinance and passed by the Board of Supervisors. These procedures generally involve submitting estimates of cost, plans and specifications, assessment districts, and detail assessments, and require the holding of formal hearings. Following through these legal steps usually consumes a great amount of time. In case of the work covered by this report, the minimum time for enacting the necessary legislation and carrying through the legal procedure would be from eighteen months to two years.

CHAPTER XI

CONCLUSIONS AND RECOMMENDATIONS

Business District Congestion

In American cities, the tendency of the business areas is toward concentration up to the point of saturation of transportation facilities. Decentralization of business begins as soon as mass transportation becomes inadequate. In some quarters artificial promotion of decentralization has been advocated as a means of traffic relief. The usual method recommended is to limit the height to which buildings may be constructed. Decentralization results in a reduced efficiency in conducting business, for with offices scattered over a large area, much time is lost by those required to make business calls and the total amount of traffic, expressed in vehicle miles, is increased. The compactness of the San Francisco business district, resulting in convenience in transacting business is one factor considered by any organization seeking a location for Pacific Coast headquarters.

Normal horizontal expansion of this district is restricted on the north by hills and on the south by the uncoordinated street arrangements at Market Street. This latter condition is the only one which can be relieved. This can best be done by cutting streets or arcades through the long blocks south from Market Street. This will tend to centralize the business district on Market Street, which is naturally the main artery of the City.

At present the traffic congestion in San Francisco is not as serious as in many other large cities. Except for the winter months, it is generally limited to a short peak during the afternoon. Adequate relief for some time to come can be obtained by abolishing parking on the main arteries of the business district during the afternoon rush. Staggering of office hours would further relieve conditions.

At present the Market Street tracks from Sutter to the Ferry Building are filled to capacity during rush hours. This naturally limits the number of cars that can be handled on the branches converging on Market Street. The combined capacity can be increased by turning off some of these cars south from Market Street as recommended in the 1929 Street Railway Transportation Report and indicated in Figure 18 herein. To satisfactorily accomplish this, unification of the two trolley systems is almost essential.

City traffic, rail and vehicular combined, tends to increase approximately as the square of the population. On this basis, San Francisco traffic should increase over 50 per cent in the next decade. The actual division of traffic between foot, motor vehicle and rail transportation will depend in a large measure upon the relative desirability of each and therefore cannot be forecast with any accuracy. However, it is certain that in the downtown area, the proportion now carried by automobiles cannot be maintained in the future; consequently, an increase in capacity of the rail transportation facilities will be needed. When saturation is imminent, the next step necessary to increase downtown traffic capacity lies in the construction of a subway.

Subway Programming

There is no definite period at which it can be stated that a subway should be constructed; that is rather a matter of opinion to be decided by all interested parties. However, it usually happens that the construction of rapid transit systems is postponed until traffic conditions become intolerable. In the meantime, the community has suffered quite a loss that cannot be measured directly. New York, after very unsatisfactory experience, is now proceeding with a very ambitious construction program on the theory that it is cheaper to build subways than not to build them. San Francisco, ever alive to its public needs, should take advantage of the time now available to make plans for carrying out the undertaking in an orderly manner.

It should be taken into account that it requires a very appreciable interval of time to build a subway after the decision to proceed has been made. It is estimated that the time required for the initial subway proposed for San Francisco would be as follows:

Collection of sub-surface information, preparation of plans, specifications and assessment data.....	2 years
Legal procedure and hearings necessary to levy assessment for portion of cost.....	1 ½ years
Work of construction	3 ½ years
Total	7 years

Thus to have subway service in readiness to meet traffic requirements, not less than seven years should be allowed in which to carry out the work.

Much detail is involved in making the sub-surface surveys, which will include not only the City-owned structures, but also everything installed under the streets belonging to the public service utilities. Carefully prepared plans and specifications going into considerable detail will be required in order to secure the lowest bids.

The several portions of the work are inter-dependent necessitating the awarding of several contracts, the first of which will have to be completed before work under the others can be carried on. The last contracts to be completed will be those covering tracks, signals and electrical facilities, work which cannot be commenced until after the subway structure is completed.

The method of financing the City's portion of the cost will have to be worked out and may have to be submitted to the people for approval. Under present conditions, the means of jointly operating both the subway and surface tracks on Market Street will have to be worked out between the Municipal Railway and the Market Street Railway. Agreements will have to be made with private corporations for abandoning and reconstructing sub-structures interfering with the subway.

It is highly important that initial subway routes be adopted at an early date. This will permit all concerned to have ample opportunity to adjust themselves to the proposed plan without confusion. It will allow the public utilities to at least partly adjust their plant so as to cause the least difficulty during the period of construction and allow for proper coordination with the plans for new construction.

Unification

Unification of the street railway systems has been stated to be most desirable in order to secure the most effective use of the present tracks and cars through rerouting, thus saving congestion, and also very desirable in connection with the operation of the proposed subway. Later when the subway system is changed from street car to train operation, it is not likely that it will be possible to continue with the dual ownership. If the present systems are not unified prior to that time, it may be necessary to operate the train subway system separate from the surface systems, which will be a disadvantage to all users as the street car lines should provide feeder service to the subway stations, thus in effect extending the subway service in the most effective manner. Street cars will for many years no doubt, have to supply cross town service. In San Francisco street cars will always continue to be of special importance because of the large hill-top population which can never be reached directly by subway service.

Organization

If the present dual trolley system is to be operated in the subway, it may be necessary to have an entirely separate organization to operate and maintain the jointly used facilities of the subway system, both surface and underground. This organization would include all of the personnel necessary to maintain service, other than car crews. Each railway's car crews would operate their cars over the tracks of the subway system under the control of the subway dispatchers and inspectors. In order to positively segregate the fares belonging to each railway system, it would be necessary to have individual coin boxes in the stations assigned to each. It would also be necessary to partition off the loading platforms to correspond. Transfers issued by surface cars would have to be exchanged at the change booths in the stations for tokens to be deposited in the coin boxes at the turnstiles.

While this plan of operation is feasible, it is unwieldy and it would be desirable in the interests of simplification to combine the trolley systems. When trains are operated, it will not be feasible to partition the platforms so as to segregate passengers of the two systems. It will therefore be evident that unification must be accomplished before the system can be changed over to train operation.

During the early history of the subway system it is unlikely that there would be a continuous program of extension. For this reason the design and construction work could best be taken care of by the City's Engineering organization. The proposed subway organization would be in effect an operating force only.

Recommendations

In the preparation of this report, studies were made of all factors bearing upon the necessity for and the most desirable routing of a subway in San Francisco. While the need for a subway can be postponed for a time by the adoption of certain expedients, it is found that the normal increase of traffic during the next decade will necessitate a subway dip along the routes proposed herein as shown in Figure 23 with a suitable extension to connect with the East Bay Bridge.

The proper time to undertake the construction of the subway can best be determined by those who must bear the cost. In making this determination, the

losses occasioned by inadequate street capacity should be balanced against the subway costs. Completion of the two projected bay bridges, with attendant influx of motor vehicles from the suburbs, will undoubtedly hasten the date when this expenditure can be justified.

It takes a period of years to design and construct a subway, but before any of this work can be started, the routes and the financial plan must receive approval. Controversies over these fundamental questions have produced costly delays in other cities and San Francisco should profit by their example. With a view toward orderly procedure, the following recommendations are submitted for immediate consideration:

1—That approval be given to the plan submitted herein for an initial subway system in which surface cars are to be operated, comprising:

(a) A four track subway on Market Street from McAllister Street to Sansome Street with a double track extension forming a loop at Battery Street.

(b) A double track extension of the Market Street subway from McAllister Street westerly to a point between Franklin and Valencia Streets.

(c) A double track branch subway leading out of Market Street into McAllister Street and terminating between Leavenworth and Hyde Streets.

(d) A double track branch subway running out of Market Street into O'Farrell Street and continuing to a point between Hyde and Larkin Streets.

(e) A double track surface line on Market Street from Valencia Street to Sutter Street to replace the present four tracks.

2—That negotiations be carried on toward unification of the Market Street Railway, the California Street Cable Railroad and the Municipal Railway, in order to pave the way for future city wide rapid transit service operated in conjunction with surface feeder lines and suburban connections to the Peninsula and East Bay.

3—That immediate relief for rush hour traffic congestion be obtained by the abolition of parking between the hours of 7:00 a. m. and 10:00 a. m. and 3:00 p. m. and 6:00 p. m. on the streets north of Howard, south of Bush, east of Ninth Street and Larkin Street, with extensions on Mission Street to Twelfth Street, Market Street to Valencia, McAllister, O'Farrell, Geary and Sutter Streets to Van Ness Avenue.

4—That the peak of rush hour traffic, both morning and evening, be reduced through arranging for staggered hours of downtown employees.

5—That officials of the Municipal Railway and the Market Street Railway be requested to cooperate in improving downtown traffic conditions by such rerouting as will relieve Market Street of unnecessary cars.

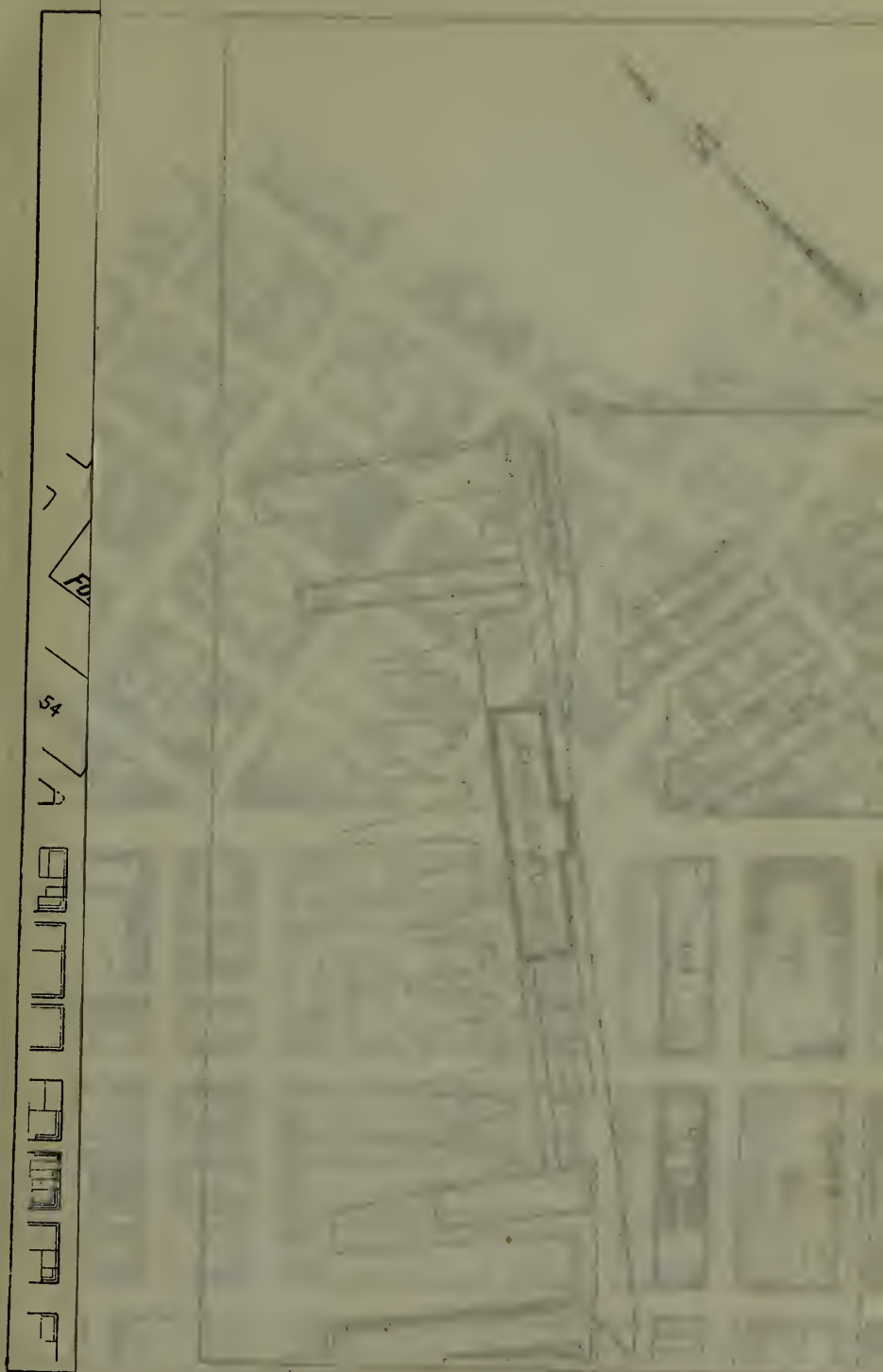
6—That legislation be developed and passed providing an equitable procedure under which not less than 50 per cent of the cost of improvements such as the proposed subway could be assessed against the property benefited.

7—That authority be granted for the making of preliminary plans and estimates for the cost of cutting new streets through the long blocks south of Market Street and that \$5,000 be appropriated for this work.

8—That authority be granted for the collection of sub-surface data over the routes proposed for the subways and that for this purpose the sum of \$25,000 should be made available for expenditure during succeeding years.

9—That His Honor the Mayor appoint a Committee of representative citizens interested in the downtown traffic, with a view to having them familiarize themselves with the views presented in this report and to secure the cooperation of property owners and organizations in order to develop a public sentiment favorable to the construction of the subway herein proposed under the method of financing recommended.

10—That copies of this report be officially furnished to all of the public service corporations and others using sub-surface space, with the request that they gradually rearrange their facilities so that the construction of the subway could be executed with the least possible expense and inconvenience to the utilities and property owners.





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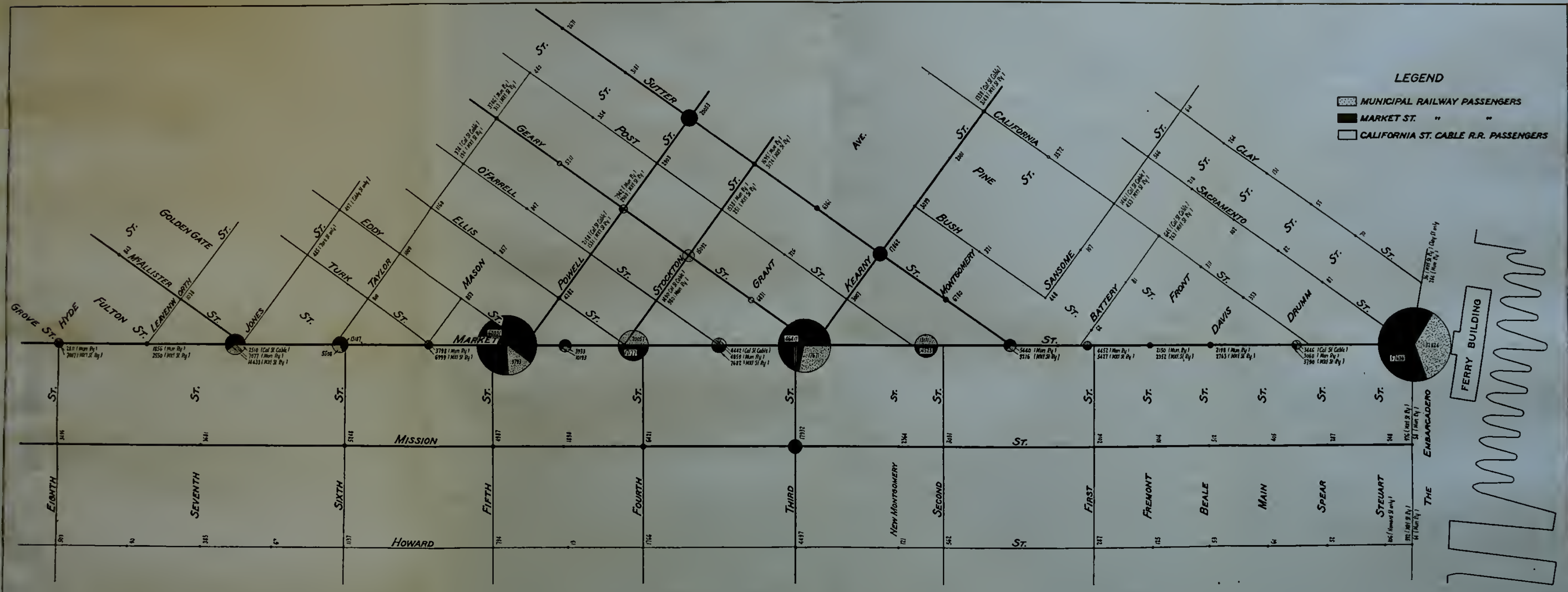


PLATE 2.—DIAGRAM OF PASSENGER ONS AND OFFS.
 Numbers at intersections indicate total passengers boarding or leaving cars at these points. These are segregated between Market Street Railway and Municipal Railway at intersections common to both systems. Figures are for a typical week day.

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PLATE 3.—DIAGRAM OF INBOUND PASSENGERS.
 Numbers indicate the week day total passengers riding inbound in each block. Width of lines indicates graphically the relative numbers of passengers. Market Street Railway and Municipal Railway passengers are segregated.

GROVE



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24



2

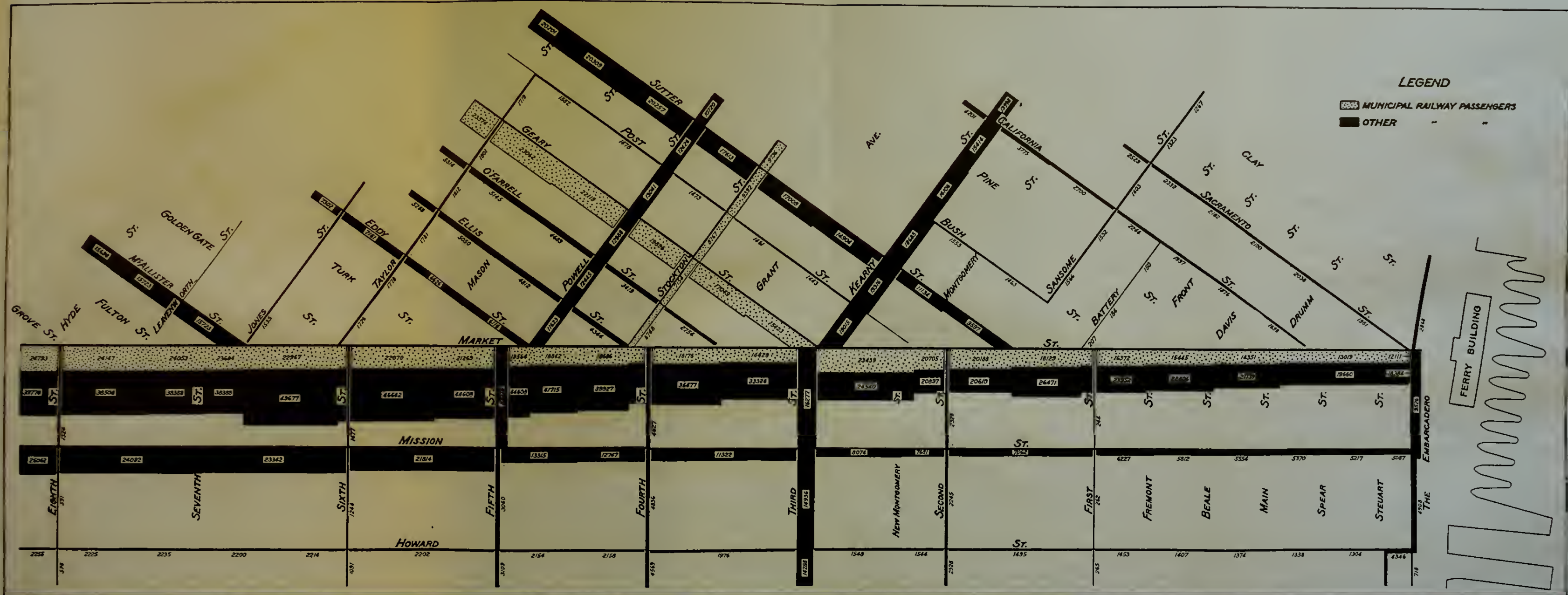


PLATE 4.—DIAGRAM OF OUTBOUND PASSENGERS.
Numbers indicate the week-day total passengers riding outbound in each block. Width of lines indicates graphically the relative numbers of passengers. Market Street Railway and Municipal Railway passengers are segregated.

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WINDWARD SIDE OF JUNCTION

VIEW TO

Grove

50

7685

453

40

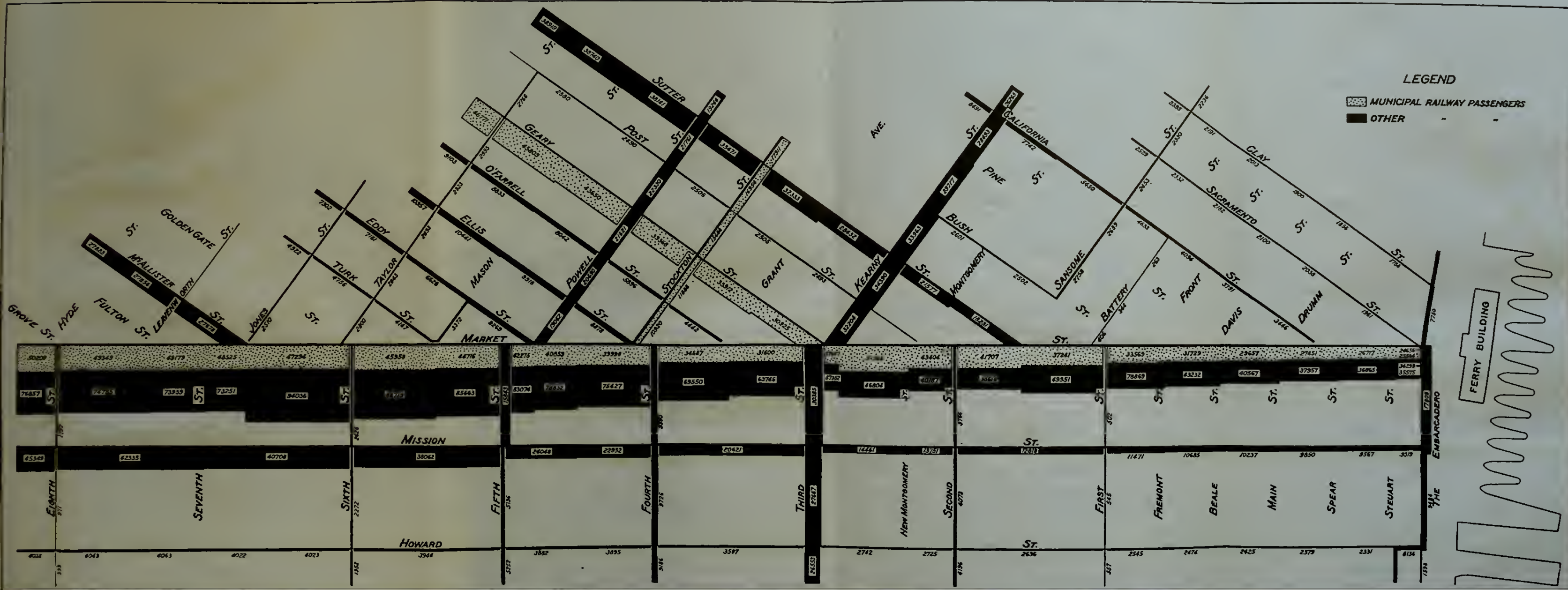


PLATE 5.—DIAGRAM OF PASSENGERS INBOUND AND OUTBOUND COMBINED.
 Numbers indicate the week day total passengers riding in both directions in each block. Width of lines shows graphically the relative numbers of passengers. Market Street Railway and Municipal Railway passengers are segregated.

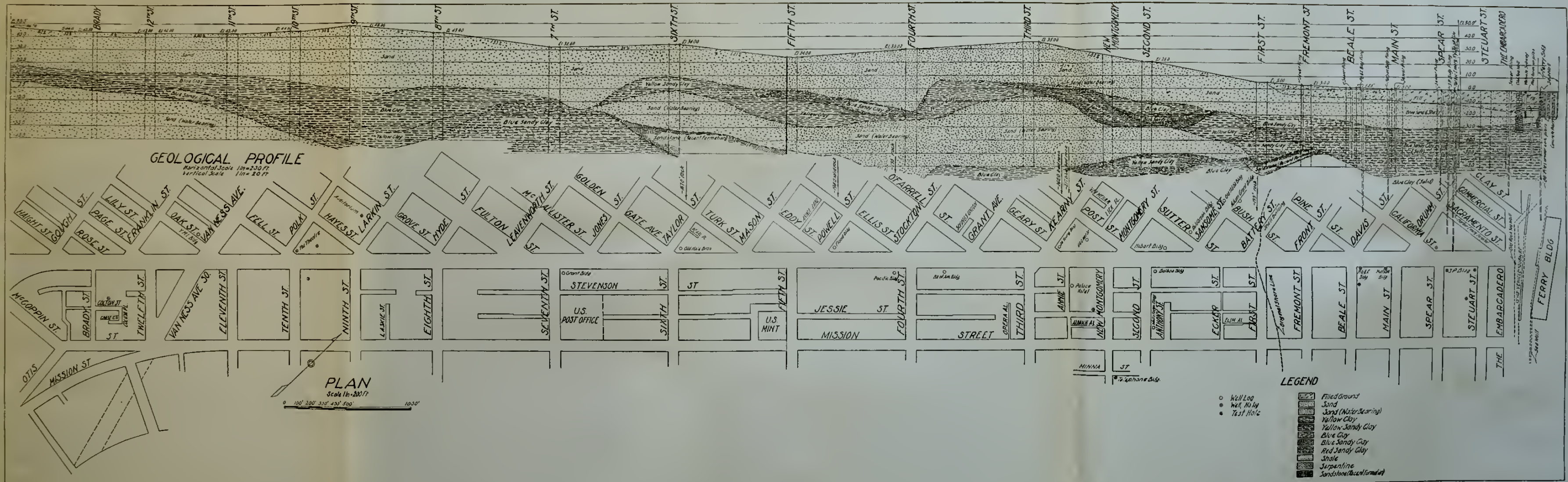


PLATE 6.—GEOLOGICAL PROFILE OF MARKET STREET, SHOWING SURFACE STRATA.

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